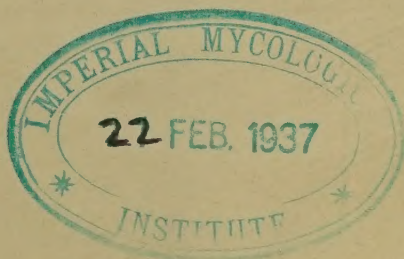


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EMPIRE COTTON GROWING CORPORATION



PROGRESS REPORTS FROM
EXPERIMENT STATIONS
SEASON 1935-1936

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LONDON
1937

**PROGRESS REPORTS FROM EXPERIMENT
STATIONS, SEASON 1935-1936.**

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PREFACE

With the exception that no report has been received from Fiji, the Progress Reports included in this volume come from the same countries and Experiment Stations as last year. The authors have, for the most part, succeeded in giving effect to the suggestions originally made two years ago as to the form into which these Reports should be cast, though, in some instances, further consideration of the principal purpose that it is hoped this volume serves will doubtless lead to further condensation in future years. As they stand, however, the Reports should constitute a source of information from which those interested can ascertain the directions in which progress is being made in Australia, and in Colonies and Protectorates in the investigation of the main problems connected with the growing of cotton and of the chief crops that can be grown successfully in rotation with it. Over a large part of Africa damage from insect attack constitutes a limiting factor in cotton-growing, and a considerable proportion of some of the reports is appropriately devoted to a description of investigations on the possibility of controlling these pests and the diseases they bring in their train.

The thanks of the Corporation are due to the authors of the several reports for the care taken in their preparation, and to the Governments of countries in which the Corporation have no staffs of their own, for their courtesy in permitting the inclusion in this volume of the reports of the Government Experiment Stations. The gain in completeness which the volume acquires, thanks to the inclusion of such reports, adds considerably to its value as an attempt to represent a general survey of of the principal cotton-growing problems under investigation.

QUEENSLAND
COTTON RESEARCH STATION, BILOELA.
PROGRESS REPORT FOR THE SEASON 1935-36.

BY

W. G. WELLS (Director of Cotton Culture),
 L. M. HODGE (Manager), Cotton Research Station, and
 W. A. R. COWDRY (Field Assistant).

The season under review has been marked by a series of contrasting conditions which seriously affected the cotton crops. The rainfall during the late winter and early spring months was excellent; in some districts three distinct satisfactory rain groups occurred in the most favourable planting period. All the intended early plantings on the Station got away to a nice start in October. The driest November in sixty years was then experienced, which was followed by a dry December as well, with the exception of a light storm group at the end of the first week of that month, which revived the early planting somewhat and enabled the rest of the cotton plantings on the Station to be completed. A good strike was not obtained in these, however, until the January rains, as no further relief was afforded before then, by which time the earlier sown plants on the older cultivations were seriously checked, the mean number of squares per plant in a 5-varietal test being only 21 at mid-January, as compared with 27 on four year old cultivation. The rains of mid-January onwards caused a marked increase in the soil moisture and nitrate content of the older cultivations, which resulted in very rapid growth of the cotton plants.

Flower production started well, but soon declined rapidly and continued at a low rate until early in February, when the crop of squares which was developed after the first rains in January commenced to flower. A rise in flower production occurred during mid-February, the sappy plants checking up quickly following a hot, dry period in the first half of that month, which was broken by a good rain and then was resumed until March, when an extraordinary period of showery, cloudy weather set in which continued for the first three weeks. Seventeen out of the first nineteen days were practically completely overcast, and a total of 5.95 inches of rain fell in the month. The result of such unusual conditions was to cause the development of a very sappy type of plant producing many small axillary branches which gave

— RAINFALL AND TEMPERATURE GRAPH - BILOELA. —

SEASON 1935-36.

THREE-DAY
MEANS FOR 10
PREVIOUS YEARS

SEASON 1935-36

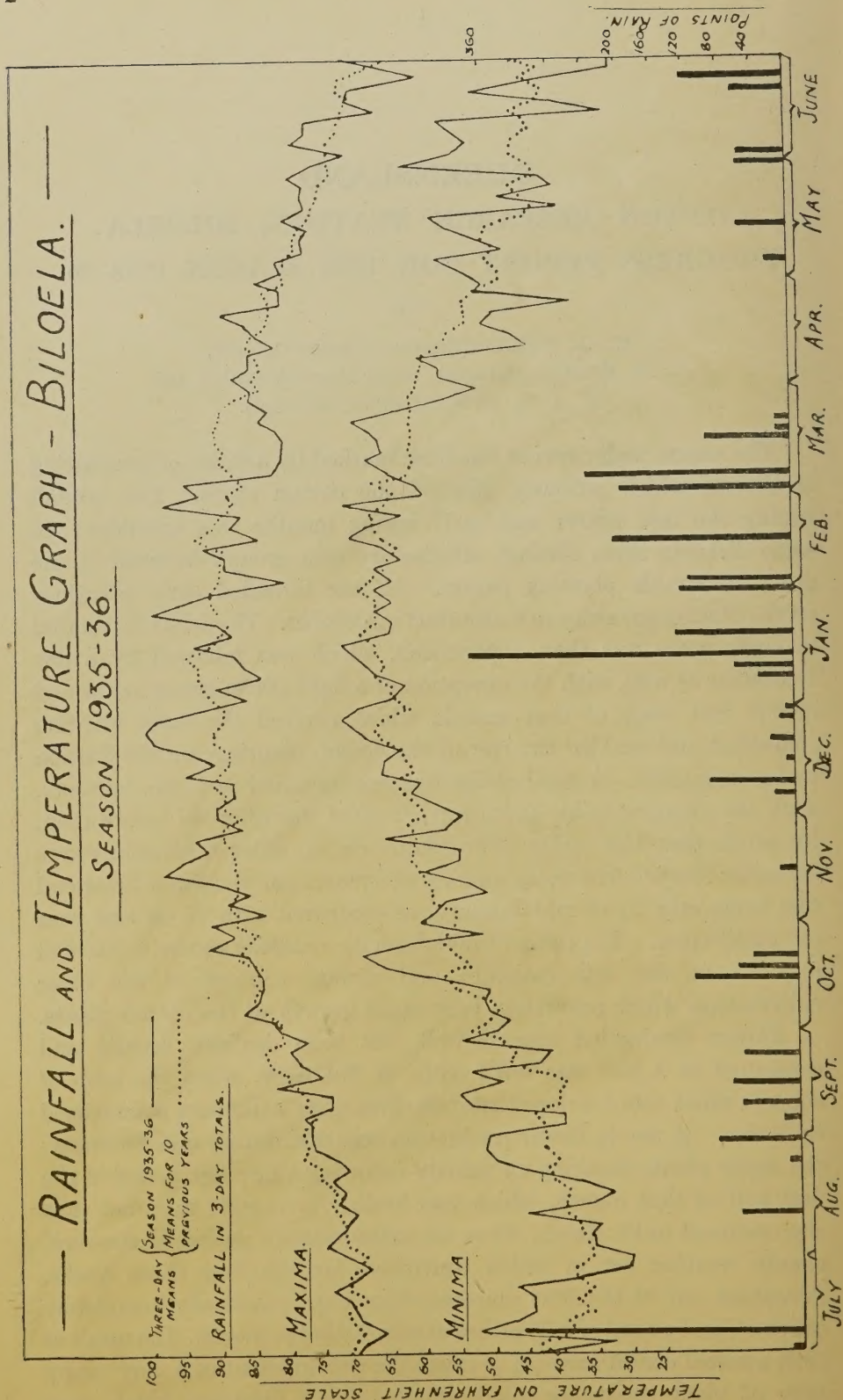
RAINFALL IN 3-DAY TOTALS.

MAXIMA.

MINIMA

TEMPERATURE ON FAHRENHEIT SCALE

POINTS OF RAIN



the plants a most bushy vegetative appearance on all except the newest cultivations. An outstanding feature of this growth was the very pronounced dark green colour of the leaves and the absence of all indications of the crop maturing, such as reddening stalks and light yellowish green leaves that are usually present during March, although the early formed bolls were opening in many fields. Apparently the plentiful supply of moisture and the very high nitrate content of the older cultivations along with the exceptional amount of cloudy weather, provided very favourable conditions for the continuation of the "mid-seasonal" appearance of the plants well past the normal period.

Such prolonged sappy growth made the plants very susceptible to the effects of the worst invasion by jassids that the station and the surrounding district have ever experienced. In a very short period most of the leaves on even the early plantings of the old cultivations, were fully curled up, and by the end of May had changed to the brownish colour typical of a jassid attack, giving the crops a "frosted" appearance. It was noted, however, that although the leaves of the plants on the newer cultivations were heavily attacked, (as many as five jassid under a leaf on several leaves per plant), on many of the heavier soils these leaves did not show the effect of the attack so quickly. This allowed the plants to function more normally for four to six weeks longer and thus enabled them to mature the top crop to better advantage, thereby increasing the yields as compared with the adjacent crops on old cultivations.

After March a period of bright weather was experienced in which the mean maximum temperature was higher than normal for April and May and the mean minimum was cooler for April, but 3.7° higher than normal for May. Such conditions continued, with the exception of a light storm group on the first of June, until the middle of that month, when sufficient frost occurred to kill the leaves and force the opening of what top crop was developed. The temperature and rainfall graphs are included to illustrate more clearly the conditions under which the crop was grown.

An average of 523.6 lb. of seed cotton per acre from 37.5 acres of October planting was obtained, with 15.5 acres of December planting yielding nothing, thus showing very convincingly the advisability of planting in October if at all possible.

SEASONAL OPERATIONS.

The work at the Station has again consisted mostly of a continuation of investigations described in the previous Reports, or amplifications

of them. The climatic conditions were in direct contrast to those of the previous season, so that the experiments of the past three seasons have been carried out under most diverse climates. Any consistent, or partially consistent, results obtained will therefore be of definite significance for the alluvial soils of the district.

PART I.

Soil Studies.—Moisture and nitrate studies were again carried out, and the results obtained were of decided value in helping to explain the yields produced in the different experiments. Soil moisture determinations made fortnightly in virgin native grassland and in 1st, 4th, 7th, and 11th year old cotton cultivations gave clear-cut indications of the markedly greater use of moisture by the grass than the cotton until the January rains developed, after which the grassland had a higher percentage of moisture at the 4–6 and 10–12 inch levels than did the 11th year cultivation, and practically the same content as the other ones. The 11th year cultivation tended to be lower than the other ages of cultivation all the season, and the 1st year cultivation had a significantly higher moisture content than the 11th year at both of the levels on many dates, particularly in the 10–12 inch level, where the difference ranged from 4 to 6 per cent. through January to April.

The usual comparison of moisture content of an old cultivation under successive fallows and successive cotton crops respectively was again carried out. The moisture content at the 4–6 inch level of the fallow, which was in the 4th year of establishment, showed a fair amount of variation ranging from a peak of 30% in wet periods to 20% following the dry November. The 10–12 inch level showed a significant diminution only during the prolonged dry period late in the season, varying remarkably little from 27% through most of the season. The moisture at the 16–18 inch level was approximately 28% all the season, except during the two dry periods when a drop of only 2%, however, was registered. The cotton area showed a significantly lower content than the fallow in the upper level, within six weeks after planting, and continued thus all the season with the exception of a fortnight in the wet period of March; at one time in the autumn the moisture content was only 10% as compared with 24% in the fallow, in the oven dried soils. In the two lower levels the cotton plants reduced the moisture significantly within two months and this continued so all the season with the exception of the wet period in March when at both the 4–6 and the 10–12 inch levels the moisture contents approximated to those of the fallow. A highly

significant difference still existed in the 16–18 inch level at this period, however, showing how 11 years of cultivation, mostly cotton, has impaired the physical condition of this soil to such an extent that the subsoil moisture at even 18 inches was not replenished very appreciably when a cotton crop was growing on it—the actual increase following a total of 17·05 inches occurring in good storm groups over a total period of 70 days, being only a rise from 20% at the start to 25% at the highest point reached.

Nitrate studies were also made in this location and indicated that following the previous dry autumn the light winter and early spring rains did not leach the nitrates to any extent, so that with the start of warm moist conditions the nitrate content increased quickly to high levels in both the 4th year of fallow and the 4th year of successive cotton, being higher than 25 parts per million of soil in the first 18 inches. The content of the first 6 inches of the fallow was consistently substantially higher than that of the plot which had had successive plantings of cotton, starting at mid-winter and continuing until the reduction of nitrates which occurred at mid-December after the long dry period, the differences ranging from 4 to 10 p.p.m. Only the larger differences were significant statistically, however, based on the mean of 10 composite samples from four bores in each level of each treatment.

A marked feature of the determinations was the extraordinary rise in the nitrate content of the first six inches following the good rain group at mid-January, when increases of 25 p.p.m. were obtained in both soils, the cotton area reaching a maximum of 45 p.p.m. A lag of a fortnight occurred before the contents of the two lower levels showed any substantial increase. This increase rose a further 8 to 10 p.p.m. in the fallow during the next fortnight, indicating further leaching to the lower levels, but in the cotton plot the plants were growing so rapidly that a marked reduction occurred in the second six inches, which was sufficient to reduce the nitrate content of the third six inches to 18 to 20 p.p.m., which was the ruling level for this zone for most of the season after the end of November. In the first six inches the utilization of nitrates by the rank vegetative plant growth was sufficient to reduce the maximum content of 45 p.p.m. to 8 p.p.m. during a steady decline lasting through February and March, at which level the content remained for the rest of the season until the 1st of June rains, following which an increase of 10 p.p.m. occurred.

The combination of moisture and nitrate studies affords a good picture of the soil environmental conditions in which the cotton plants grow in the older cultivations, and indicates the direction in which

improvements must be made to restore the suitability of the older cultivations of the fertile alluvial clay loams for the production of the maximum yields of cotton that they are capable of producing when in the proper condition.

The experiments of Latin Squares of five varieties on different ages of cultivation that have been described in the last two Reports, were again carried out on the same sites, the soils having been in the 11th, 7th, and 4th years of cultivation of successive cotton crops. A first year of cultivation treatment was also included this season. After the thinning to 2 ft., single plant, spacing was completed, counts of population indicated once more that the percentage of perfect spacing in the 1st year following grassland is somewhat less than in the older cultivations. Fortnightly height measurements of 50 plants in each variety on 11th, 4th, and 1st year cultivations indicated that the plants on the new cultivation tended to grow at a slower rate than those on both the 4th and 11th year cultivations, those on the latter cultivation were also slower than those on the 4th year, until the February rains, after which there was little difference. Flower counts on five 100 ft. row lengths of each variety on each age of cultivation indicated that flowering during the first 5 weeks of counting was in the ascending order of 1st, 11th, 4th, and 7th year cultivations. For the next four weeks, extending through good growing conditions, the 4th year was ahead or equal to the best, with the oldest cultivation dropping definitely below the rest where it stayed until the last two weeks of counting when the 4th year shared last position with it. The new cultivation on the other hand, while slow to start and not equalling the 4th year until the 7th week of counting, tended to be on a higher plane than the others for most of the last month of counting. This was also shown in the amount of top crop set by the plants in this treatment. Crop possibility counts (total number of fruiting nodes on a plant) on 50 plants in each variety on the 1st, 4th, and 11th years of cultivation indicated at mid-January that the 4th year had produced practically twice as many possibilities as the 1st year, and 41% more than the 11th year old cultivation. A greater percentage of shedding occurred in the 4th year than in the 1st year, however, for the former had only 71% more forms (squares and bolls) set than the latter. The rate of shedding was about the same in the 11th and 4th year cultivations, the 4th year having 40% more forms compared to 41% more possibilities. A further possibility count early in March indicated a decided increase in the rate of production of possibilities in the 1st year cultivation, which had 6.3 times more than at the first count; the 11th year was next with 4.9 times more

and then the 4th year with 4 times more than at the first count. The efficiency of setting of forms on the 1st year cultivation increased markedly compared with the others, for the 4th year instead of having 71% more than the 1st year, as at the first count, had only 92% as many. It still had 16% more than the 11th year, however.

Determinations of the percentages of plants without terminal buds soon after the plants were thinned to the final spacing, indicated that there were definitely fewer terminals lost on the 1st year cultivation, with the greatest number on the 4th year. Counts made at mid-March of plants which had terminals at the 21st January indicated that severe losses of terminals occurred during the wet season, the percentages of terminals lost during that period being the greatest for the oldest cultivation, with the 4th and 1st year equal.

The mean yields obtained in each treatment indicate that the newer cultivations produce the highest yields. Unfortunately calves from a neighbouring farm crawled under the fence and destroyed the top crop of the 1st year cultivation, so no comparable data from it can be presented. The yields of the 4th, 7th and 11th years of cultivation were respectively 1,025, 947 and 522 lb. seed cotton per acre. No significant differences between varieties in a treatment were obtained, except in the 4th year of cultivation where the two varieties that have led in most trials on these soils again outyielded the ranker growing and slower maturing varieties. The rankest growing variety once more gave the lowest yield on the oldest cultivation, thereby confirming previous results, that in seasons experiencing wet conditions during February and March, rank growing varieties on the older cultivations suffer severe loss of crop from various causes.

Ginnings of the bulk pickings of the three inner rows of each plot of a variety indicated that there was little difference, if any, in the lint percentage of a variety on the two older cultivations, but there was a tendency for it to increase on the 4th year of cultivation, except in the variety with the lowest percentage. On the 1st year cultivation, however, the variety most suited to fertile soils had a lower percentage than it had when grown on even the oldest cultivation—indicating a possible shortage of nitrates for it. The mean lint percentages obtained from 60 individual plants of each variety on each age of cultivation, with the exception of the 1st year, where all of the varieties had a higher lint percentage than on the other ages of cultivation, although not significant statistically in one case, tended to confirm the results obtained in the bulk ginnings. The lint indices likewise showed a tendency to be higher on the newer cultivations, significant differences being obtained in most varieties.

Data collected from the same plants indicated that there was a marked reduction of bolls on the vegetative branches, expressed as a percentage of the total on the plant, on the oldest as compared with the 7th and 4th year, but not on the 1st year of cultivation. There was a marked tendency, though not significant statistically, for the varieties to have a lower percentage of 5-lock bolls on the newest cultivation. Also, while not significant except in a few instances, there was a definite tendency for the seed cotton of both the 4- and 5-locked bolls to weigh more on the 4th year of cultivation than on either the 11th or 7th year. Compared with the 1st year of cultivation, however, a significant difference was obtained in favour of the 4th year. There was likewise a tendency for the 4th year cultivation to have more seed per lock than the other ages of cultivation, the 1st year again being significantly lower, except for the variety best suited to the most fertile soils. There was no consistent trend regarding the number of motes per lock.

Root measurements taken on 60 plants on each age of cultivation as they were ploughed out, indicated that the difference between the 11th and 4th years of cultivation, while not so great as last year when they were in the 10th and 3rd years of cultivation, still showed a tendency for the plants on the newer cultivation to have better root systems. There was little difference between the root systems on the 7th and 4th years of cultivation, but both tended to conform with that of plants on the 11th year rather than with that on the 1st year, in both type and size. There were more fibrous laterals in the 1st year than in any of the other cultivations.

Sievings of the soils of the 1st and 11th years of cultivation made after the ploughing at the end of the season indicated that by weight there were in the 11th year cultivation significantly more clods in the classes of $1\frac{1}{2}$ " diameter or over in size, and $\frac{3}{4}$ " to $1\frac{1}{2}$ ", but no difference as regards clods of $\frac{1}{2}$ " to $\frac{3}{4}$ ". There were significantly more of the classes $\frac{1}{4}$ " to $\frac{1}{2}$ ", and $\frac{1}{8}$ " to $\frac{1}{4}$ " in the 1st year of cultivation, but no difference existed for particles finer than $\frac{1}{8}$ " although in this class the soil of the newer cultivation was more crumbly in structure.

Spacing Tests with Indio Acala variety.—Spacing tests in this variety, as described in the last two Reports, were again carried out on the same sites as in the previous seasons. Although the seasonal conditions markedly reduced the mean yield of both the experiments, that on the third year of cultivation out of original grassland was again ahead, being 562 lb. seed cotton per acre compared with 304 lb. for the 11-year cultivation. With such a low mean yield in the older cultivation, plot variability markedly affected the uniformity of results and no significant differences were obtained, although the data

indicated that leaving the plants unthinned or blocked out in 7-inch hoe width bunches, spaced 1 ft. apart, markedly reduced yields. Spacing to 2 ft. apart either as hoe width bunches, singles or doubles all yielded gains over unthinned that would have paid for the cost of thinning and still left an appreciable profit.

On the newer cultivation the "Z" test was significant for $P = .05$, and here 2 ft., single spaced plants significantly outyielded 1 ft. hoe widths and unthinned by 273 lb. seed cotton per acre. Although there were no significant difference between 2 ft. singles, doubles, or hoe width bunches, the smallest difference, that of 2 ft. doubles or 2 plants per hill, was 96 lb. seed cotton per acre, with 2 ft. hoe widths and 1 ft. singles 138 lb. less than the 2ft. singles. The results obtained in both tests would thus tend to indicate that crowding of the plants was harmful under the conditions in which the experiments were conducted this season.

In the previous trials of this experiment 1 plant spaced 1 ft. apart was ahead on both ages of cultivation in a good season, and was as good as any in the other season, when the extremely dry second half tended to level out spacing influences. The tendency for the wider spacings to produce more cotton this season may be explained by the flower production, the older cultivation showing a marked reaction to the peculiar combination of hot dry weather broken by heavy storms that was experienced during the critical flowering periods, while in the newer cultivation which flowered at a lighter rate during the first half than did the older cultivation, the 2 ft. single spacing was the most regular in the second half. The net result was that there was very little difference in the mean yields of the two cultivations at the first picking, but the almost total lack of production on the older cultivation at the second picking gave the newer cultivation a substantial lead. At the second picking the 2ft. single spacing was definitely superior to all other spacings.

Ginnings of the bulk pickings of the 3 inner rows of all of the plots of a spacing were made for each age of cultivation and while no consistent trends of the effect of spacing were obtained, there was a definite indication that the newer cultivation tended to produce fibre of better strength, body and drag. The mean lint percentages obtained on each age of cultivation were also in favour of the newer cultivation. There were no consistent trends regarding effect of plant spacing on lint percentage in the newer cultivation, but in the older one the mean of all the spacings in which there was some competition effect was higher than the mean of the 1 and 2 ft. single spacings. It would appear therefore that in this season, on the old cultivation, the heavier

yields of seed cotton of the wider spacings reduced the lint percentages of the cotton produced, but on the new cultivation with more moisture this effect was not experienced.

The results obtained over the three seasons which covered a range of combination of climatic conditions representative of those likely to be experienced in Central Queensland, indicated that it pays to thin the Indio Acala variety. The best distance to space the plants would appear to depend on the soils and the seasonal conditions experienced, but for most of the soils on which this variety is usually grown the spacing of single plants 1 ft. apart appears to be a suitable distance.

Spacing Test in Other Varieties.—The spacing tests in the Cliett variety to test the effect of plant spacings on different ages of cultivation, which was described in the last Report, were again carried out. From the type of growth of the plant, it was assumed in this experiment that some form of thinning would pay in the Cliett variety, so only spacings of 1 ft. and 2 ft. singles and 2 ft. doubles were tested. The experiment was repeated on the same sites, which were respectively in the 4th and 11th years of cultivation. No significant differences were obtained in either experiment, the mean yields on the older cultivation being very low owing to the adverse conditions during the first half of January when flower production was seriously reduced, and continued so into February, thus showing the excessive shedding that occurred in this variety prior to the January rains. In both experiments the yields obtained in the 2 ft. and 1 ft. single spacings, which were practically equal in each location, were somewhat ahead of the 2 ft. doubles. The mean yield of the newer cultivation was again superior to that of the older one, 839 lb. seed cotton as compared to 285 lb. seed cotton per acre.

Bulk ginnings indicated that the cotton obtained from the wider spacings on the newer cultivation contained less leaf, and was slightly stronger at the first picking, than that from the 1 ft. spacing, but at the second picking, the 1 ft. spaced cotton, although of the same character as the others, was of higher grade. Only one picking was obtained on the older cultivation and the wider spacings were again better than the 1 ft. spacing in grade and character. The grades and the strength of the cotton picked from the newer cultivation were better at each plant spacing.

A similar experiment in the Durango variety on adjacent seven year old cultivation, although producing at the mean rate of 1,043 lb. seed cotton per acre, also failed to yield significant results. As has been often found in spacing tests of this variety, the single plants spaced

2 ft. apart gave the best results, with the 2 ft. doubles approximately intermediate between 1 and 2 ft. spacing. Apparently the slower production of flowers in the 2 ft. single spacing of Durango enables plants of that spacing to stand up to stress conditions better, and with the greater production of flowers during the latter half of the season, when the top structure of the large vegetative branches that are developed in this spacing flowers heavily, more bolls come through to maturity under conditions of a long frost-free autumn such as was experienced this season. Examinations of bulk ginnings of this experiment failed to detect any consistent differences in grade or character of the fibre produced in the different spacings.

The results obtained from the various spacing tests would indicate that plant spacing on the alluvial clay loams of the Callide Valley does not effect yields as much as does age of cultivation—in no experiment did any spacing on the older cultivation outyield any of the spacings on the newer cultivation. Sufficient spacing to reduce injurious competition during short stress periods or to avoid the promotion of excessive plant growth during very wet conditions is highly advisable, however, on all ages of cultivation. In four out of five tests this season, involving three varieties, single plants spaced 2 ft. apart produced the highest yields.

SUMMARY OF PART I.

The results obtained from the experiments that have been reported above confirm most of the findings of previous seasons, especially as to the value of planting on the newer cultivations. As the season was one in which insect attacks were experienced, particularly corn ear worm and jassids, the confirmation of previous results in such a convincing manner would indicate that under a wide range of climatic conditions, either with or without insect attacks, the alluvial soils of the Research Station, will generally produce better on the newer cultivations. As these soils are representative of large areas in the Callide Valley the findings are of definite economic importance.

PART II.

Rotations.—The usual series of rotation plots was planted and once more evidence was obtained indicating the advisability of sowing at a slightly heavier rate after fodder crops than after cotton. When thinning was completed, a count of population of the 2ft. spaced plants showed a mean of 99% perfect stand following cotton and 96·7% following fodder crops. Seed beds following Sudan grass and saccaline

are of a particularly cloddy, open nature, if of old clay loam cultivations, and sowings of at least 20 lb. delinted seed per acre when the cotton rows are spaced 4' 6" apart are undoubtedly advisable on them, if germinating moisture is not abundant. Flower counts on cotton following maize, cotton, saccaline, and Sudan grass indicated a superiority in the order stated, with cotton following maize outstandingly ahead, being approximately 9 flowers per plant per week better during the critical dry period in January. In several previous seasons superior yields have been obtained following maize, when dry conditions ruled throughout the mid-season. It is possible, therefore, that the amount of residual moisture after maize is the explanation of the gains obtained in seasons experiencing stress conditions.

The maize crops of the 1934-35 season were severely checked and produced but little grain, owing to the exceptionally dry late summer and autumn, whereas the saccaline yielded 13.7 and the Sudan grass 7.9 tons green weight, respectively. Soil moisture determinations showed this season, however, that where cotton followed Giant Setaria yielding 22 cwt. dry hay per acre, there was a good supply of moisture at the start of the season, which was not depleted until after March, when the long dry period set in. There should therefore have been fair moisture following the saccaline and Sudan grass. The fact that the plants following saccaline and Sudan grass were definitely more leafy and vegetative throughout the whole season would indicate that there was probably more nitrate present, even when such heavy nitrate-feeding plants as these two crops had preceded the cotton. Determinations made in a previous season showed that the nitrate content of either late mid-season or early winter ploughed giant setaria stubble starts increasing within a month after the ploughing, so it is possible that with the good spring rains this season decomposition of the old roots of the saccaline and Sudan grass was ample to provide sufficient nitrates to cause vegetative growth of the cotton plants for most of the season. Cotton following Giant Setaria (giant panicum), in a season experiencing good mid-seasonal growing conditions, again failed to yield as much as where cotton followed cotton. The mean yields over the nine years* in which the experiment has produced comparable crops now show a gain of only 26 lb. seed cotton in favour of cotton following setaria. Root measurements of the cotton tended to indicate that a nitrogenous effect was operating following the setaria as evidenced by a significantly larger tap root

* In the last Report the results were accidentally included of one season in which the stand was so unequal as to make the yield not comparable. The number of years of comparison thus still reads nine years.

seven inches below the cotyledon scars, and a tendency for larger stalks at that point.

The cotton planting following the third season of ploughing up of the two-year-old Rhodes grass plots was unfortunately delayed by the adverse conditions until the mid-December planting. No yields were realised from either successive cotton or the third planting of cotton after grass. A more comprehensive experiment to determine the effect of three years growth of Rhodes grass, will be started in the coming season.

The results obtained so far in the rotation studies indicate that none of the ordinary fodder crops that can be grown in the Callide Valley gives any consistent economic benefits to the cotton grower. Maize tends to improve subsequent cotton yields in dry seasons, but the yields of maize are often so low as to produce returns that will not compare with those obtained from a fairly poor cotton crop. Giant setaria, tends likewise over a long series of seasons, to improve cotton yields somewhat, but crops of 1 to 2½ tons of hay in conjunction with the small gains of cotton obtained, are not of equal value to the returns that have been realized at the Station where successive cotton crops have been grown under the regular cultural methods. The results obtained where cotton is grown in rotation with grassland, indicate definite possibilities, however, of improving the returns realized from cotton, as well as of obtaining good values from the grassland both as hay and for grazing purposes. A large part of the soil and rotational investigations carried out at the Station in the future, will therefore deal with the various aspects of such a rotation.

ENTOMOLOGICAL NOTES.

Once more attacks by various insect pests played an important part in the yields obtained at the Station and in the surrounding district, particularly on the older cultivations and in the late plantings on all classes of cultivations. The usual visitations associated with early growth, of migrations of cut worms and corn ear worms, and attacks by thrips, jassids and, to a lesser extent, aphids, were experienced over practically the whole of the early October plantings when the seedlings were 4 to 5 inches high. The usual poison baiting controlled the migrations, but severe terminal loss resulted from the other attacks, which caused the development of a rank vegetative branch system. Late October plantings, however, which developed during the dry November conditions, did not show such malformation, being singularly free of insect attacks of this nature. A rather moderate but persistent corn ear worm attack continued throughout the wet season which

undoubtedly caused severe loss, particularly on the older cultivations. A very severe jassid attack throughout the Station and surrounding district was the outstanding entomological feature of the season and but for this, many crops would have yielded decidedly better. As described elsewhere in this Report, early planted crops on new cultivations suffered less from the various attacks, as measured by yields obtained, than did either early planted crops on old cultivations or late planted crops on any class of cultivation.

SOUTH AFRICA

COTTON EXPERIMENT STATION, BARBERTON.

PROGRESS REPORT FOR THE SEASON 1935-36.

COTTON-BREEDING AND FIELD EXPERIMENTS.

BY

D. MACDONALD AND W. L. FIELDING.

Season and General.—The total rainfall for the past season amounted to 24.38 inches, a slightly higher total than the mean for the previous five years. The distribution was again very uneven throughout the season, no real planting rains falling until December 19th, with the result that the cotton crop both on the Station and in the district was planted 6 to 8 weeks later than what we have come to regard, from past experience, as the optimum planting time.

A fall of 1.05 inches on 24th and 25th October was sufficient to risk planting cotton on the light granite soil portion of the Station, but not sufficient to wet the heavier red loam soil. The above cotton germinated well, but was destroyed by a dust storm caused by a very heavy wind on November 26th.

A planting on the granite soil was again risked on 9th December, following 0.56 inches of rain, and ultimately gave the highest yield of lint per acre on the Station.

The cotton on all the red loam portion of the Station was planted from 21st–24th December following 1.46 inches of rain on December 19th, practically full stands being obtained. Growth conditions from planting until the end of January were excellent and the crop made rapid progress, but a long dry period from the end of January until March 22nd, during which no really effective rain fell, gave the crop a very severe set back. From March 22nd onward unusually heavy rains were experienced until towards the end of May. April and May are normally dry sunny months promoting the rapid development and clean opening of the crop, but this season the wet and comparatively sunless conditions prevailing, while retarding the ripening of the crop, facilitated the development and spread of bacterial boll disease, which adversely affected many of the crops in the valley. On the Station the first pickings opened well, but in the later pickings boll opening was not too good and the quality of lint and seed was impaired.

The drought beginning in February, 1935 and continuing until mid December prevented much winter ploughing being done in the

district and this reduced the acreage under cotton as compared with the previous year. As the climatic conditions in the district were similar to those experienced on the Cotton Station the total production of cotton was correspondingly lower than in the previous season.

Damage by American bollworm both on the Station and in the district was negligible, but Red bollworm, bred up in ratoon and standover cotton, caused serious damage on adjoining fields of plant cotton. Jassid was not present in sufficient numbers to cause any damage, while serious stainer damage was limited to areas where ratoon cotton was grown in close proximity to plant cotton.

Reference was made in last season's report to areas of poor growth and patchiness. These areas were mapped and the fields re-planted with cotton this year, in order to see if poor growth appeared in the same places again. Poor growth and patchiness were again very evident, but in very few cases did this show up in the same places as it had the previous year. Practically every patch of poor growth was associated with a heavy infestation of aphid, and closer investigation showed that in the centre of each poorly grown area a nest of black ants occurred. Specimens of these ants were identified by the Imperial Institute of Entomology as *Myrmecaria natalensis* Sm. var. *obscuriceps* Sants. Dr. Santschi (1) has shown that this species fosters aphid for their secretions, and it is also possible that the ants, by destroying the natural enemies which normally keep aphid in check, allow aphid to breed up to such an extent as to be definitely harmful to the growth and development of the cotton plant. Attempts were made to destroy the ant colonies by pumping Cyanogas into the nests, but this method was not entirely successful. Large numbers of worker ants were destroyed, but the gas failed to penetrate the innermost recesses of the nest and destroy the queen and the brood.

Krishna Ayyar (2) has found that soaking the nests with a solution of potassium cyanide, 1 oz. in 1 gallon water, is effective in controlling the common black ant, *Componotus compressus*, in India, and a trial will be given to this method as soon as ant activity begins in Spring.

Kraal Manure and Spraying Experiment.—In order further to investigate aphid damage and poor growth, a 2½ acre field of cotton (strain 052) was laid out in a randomized block experiment having 4 treatments :—

(1) Kraal manure, at the rate of 5 tons per acre.

(2) Kraal manure, at the rate of 5 tons per acre, plots sprayed with paraffin soap emulsion.

(3) Nil.

(4) Nil Plots sprayed with paraffin soap emulsion.

(1) Extrait des Annales de la Société Entomologique de Belgique. Tome LXVI, 1926.

(2) Bull. Ent. Res. Dec. 1935.

Aphis attacked the crop in January and the plots were sprayed on 24–25th January with a 1 in 20 solution of soap $\frac{1}{2}$ lb., soft water 1 gallon, paraffin 2 gallons. The spraying destroyed the aphis, but caused damage to the leaves of the plant by burning and the plots became reinfected by aphis before they recovered from the set back caused by spraying. There was no significant difference between the final yields from sprayed and unsprayed plots, but the difference between the kraal manure plots and the Nil plots was very significant. The yields were :—

Kraal manure	909 lbs. seed cotton per acre
Nil	465
Difference required at P = .05,	82 lbs. "per acre.

Selections.—A total of 451 lots, consisting of single plant selections and special bulks, was carried on from the previous season. Of the above total 389 lots were from U.4 selections while 62 were from the (U.4 $\times$ Cambodia) $\times$ U.4 crosses made by Harland. Over the greater part of the area occupied by the selections growth was sufficiently good to enable trustworthy comparisons to be made between lots. In the 1934–35 Report it was stated that two families, 920 and 921, occupied a block where growth was so bad that no progress could be made with them. To obviate a repetition of this so far as possible, the families were planted on both granite and loam soil on the Station as well as on a farm in the district. Over the greater part of the block occupied by these two families growth was good and excellent progress was made with discarding the inferior groups within the families.

The early strains 052, 951, and 998 again showed up well in Variety Trials and Selection Plots, and it is becoming increasingly clear from past seasons' experiences that early types, provided they have the combination of heavy fruiting and good ginning outturn, are likely to provide the *safest* type of cotton for conditions in the low veld of South Africa.

052, the strain issued for general cultivation last season, possesses these characters, except that its average ginning percentage is slightly lower than that of most of the early strains. Re-selections from it have been made with a view to increasing the ginning percentage without impairing its desirable characters. Accurate determination in the laboratories of single plant characters, in selections made during the past season, was rendered difficult by the damage caused by bacterial boll disease, and this necessitated a larger number of strains than usual being carried forward for future trials.

All the crosses carried forward from last season were from the (U.4 $\times$ Cambodia) $\times$ U.4 group ; on the past season's work they

have now been reduced to slightly over thirty lots, which will be carried on in the form of Special Bults.

One of the main reasons for making the above cross was to attempt to get increased resistance to jassid, combined with the desirable fruiting characters of U.4. So far as fruiting is concerned, the best of the crosses retained do not appear to be quite up to the standard of the best U.4 strains, but show good resistance to jassid. As jassid attack was comparatively light during the past two seasons, in order to get a line on the comparative resistance of the lots retained, part of the seed will be utilized for plots interplanted with Bancroft cotton, (a strain very susceptible to jassid) in order to subject them to a very severe attack from jassid bred up on Bancroft and migrating to the crosses when the Bancroft has been killed off. The leading U.4 strains will, at the same time, be tested in a similar manner.

Variety Trials.—The trials planted consisted of:—

- (1) Trial of 13 main parent strains on both loam and granite soils on the Station and also on a neighbouring farm.
- (2) Trial of early strains.
- (3) Trial of strain 920 and re-selections from it.
- (4) Trial of strain 921 and re-selections from it.
- (5) Trial of strain 9264 and re-selections from it.
- (6) Trial of a collection of late strains.

Statistically significant results were obtained from all trials but No. 6 and No. 1 on a neighbouring farm. In the case of trial 6 uneven growth and aphid damage rendered it useless, while Red bollworm, coupled with drought, spoiled No. 1. Strain 052 was included in all trials in order to get a direct comparison between it and all other strains. Although not coming out top in every test it gave the highest yield of lint per acre in three out of six trials, a very satisfactory performance under the past season's conditions. Two other strains which did well were 951R. and 998R., both early and slightly higher ginning types than 052. Of these, 998R. has done very well at Magut during the past three seasons.

Taking the average yield of all strains in each individual trial as 100, the following table shows the yields of the above strains as a percentage of the average yield.

	Granite V.T.	V.T.1.	V.T.2.	V.T.3.	V.T.4.	V.T.5.
Mean yield of all strains ...	100	100	100	100	100	100
052 ...	98	101	112	113	111	123
951R. ...	104	104	111			
998R. ...	100	112	108			

The yields of lint from variety tests on the loam soil, ranging from 120 to 215 lbs. lint per acre, were considerably lower than previous season's yields, but this is accounted for by a proportion of the crop failing to open.

The variety test on the granite soil planted on 9th December, a fortnight earlier than the main Station trials, gave extraordinary high yields. The lowest yield was from strain 0338R giving 437 lbs. lint per acre, the highest yield being 536 lbs. from 0342R. 0342R is a re-selection from strain 9264R, which showed up so well in the flowering curve published in last season's report. The flowering curve, Fig. 1 (on the following page), for two good strains shows that 0342R and 052 were producing, during the period February 29th–March 14th, from 6 to 11 flowers per plant per week. The sudden drop in the flowering curve after that is only to be expected, considering the long drought from January 30th until March 13th and the crop set during that period, as shown by the final yield.

The high yields of lint per acre from this trial are probably due in part to manurial treatment. Normally the trial would have had a dressing of 200 lbs. superphosphate per acre only, but nitrate of soda having given such good results on granite soil the previous season, it was applied to the trial as a top dressing on February 3rd at the rate of 200 lbs. per acre. This undoubtedly helped to stimulate flowering and push on the development of the crop.

Fertilizer Experiment.—The fertilizer trial on the loam soil having carried a cotton crop for four years was discontinued as it was felt the land required a change of crop. It was planted with tepary beans and the results are given in the Rotation Crop section of the report. On the granite soil, the fertilizer experiment started last year was continued. Red bollworm and drought prevented reliable yield figures being obtained, but plant samples taken from the experiment on 23rd January gave the following results.

						Green weight, gms.	Dry weight, gms.
N	...	...	...	...	...	632	117
P	...	...	...	...	...	514	104
K	...	...	...	...	...	433	87
Nil	...	...	...	...	...	392	79
P=·05						81 gms.	14 gms.

Uniformity Trials.—During the past season two fields of 052 cotton were used as uniformity trials in order to attempt to find out the optimum size of plots and blocks to be used in variety trials under local conditions. Further trials will be carried out during the coming season and a report on the above work will be written up in due course.

Development.—A Silverlite petrol gas plant has been installed and connected up to the laboratories.

During past years the water supply required on the Station for laboratories, cattle and mule troughs was derived from a sunken well. The supply from this source was not satisfactory on account of

temporary breakdown of pump, silting of well, etc., and accordingly during the past season the Station was linked up with the Barberton water supply by a 1" pipe line.

A cattle kraal has been constructed and pits dug in order to compost the waste products of the Station by the Indore process during the coming season.

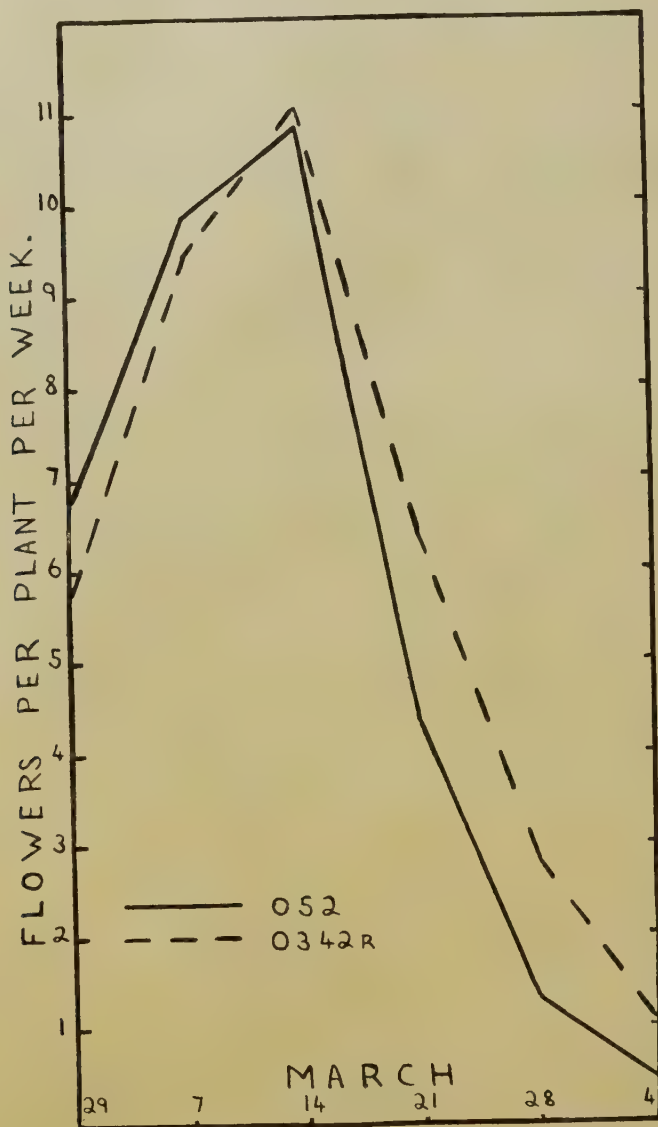


FIG. 1.

PLANT PHYSIOLOGICAL WORK.

BY

D. F. RUSTON.

Work in this section was concentrated chiefly on the Rotation Experiments, while a new potash-nitrogen trial, designed to investigate the interaction between these two manures, was also started.

The layout and experimental technique of these experiments were all planned by Mr. O. V. S. Heath, the writer having only taken over the work in May of this year.

Rotation Experiments.—Work on the rotation experiments was carried on as in the previous years. The experiment is carried out on both the loam and granite soils and is designed as a trial of six different two-year rotations, each rotation including cotton. One half of the area of the experiment is planted to cotton, while the other half is under the six different rotation crop treatments (cotton, fallow, maize, sunflowers, tepary and soya beans).

Loam Soil. Sub-experiment B.—This field was planted with 052 cotton on December 22nd, 1935. Growth on the experiment was poor, the cotton suffering very badly from attacks of aphid, while shortage of phosphate, which had not been applied since the experiment was started in 1932, may also have affected the yield.

Sampling was carried out at intervals throughout the season. At the first sampling on January 7th, the fallow treatment showed a definite advantage, the dry weights per seedling being significantly higher than any other treatment except maize. A fortnight later, however, this initial advantage had been lost and measurements of plant height showed fallow to be significantly lower than the sunflower, cotton and tepary bean treatments.

This year's figures confirm the results of the two previous seasons *i.e.*: that fallow gets away quickest, then falls below most of the other treatments, but recovers again and goes ahead before flowering. Samples taken at the beginning of March showed fallow to be second only to sunflowers in height, while the final height measurements, taken on July 7th, showed a definite and very significant advantage in favour of the fallow treatment.

A graph (Fig. II on the following page) of the growth curve of the cotton following the six different rotation crop treatments has been plotted from the measurements taken on January 7th and 24th, March 3rd and July 7th. This shows very clearly the extent to which the fallow treatment benefits the succeeding cotton crop in the later stages of its growth.

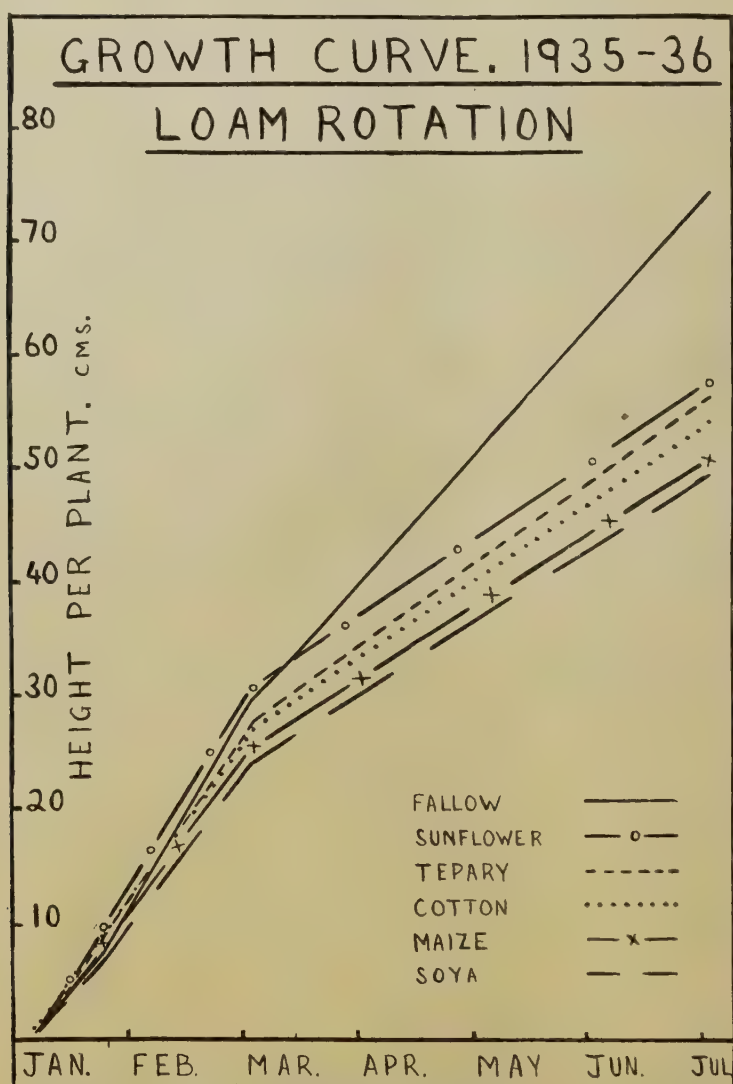


FIG. II.

Another interesting point in the graph is the difference between the sunflower and soya bean treatments all through the season, particularly in view of the fact that the sub-soil moistures for these two treatments were practically identical after the two rotation crops were removed in July 1935, and so presumably were also equal at the time of planting. The sunflower plots had a moisture content of 14.02% and the soya bean plots one of 14.00%. These two plots were significantly drier than all the other treatments at July 1935, so the results this year show that the differences in the moisture content between the different rotation crop treatments

are not the only factors affecting the growth of the succeeding cotton.

The total yields of the rotation experiment showed a close correlation to final plant height, and the superiority of the fallow treatment was again evident.

TOTAL YIELD IN LBS. PER ACRE OF SEED COTTON.

<i>Fallow.</i>	<i>Tepary.</i>	<i>Sunflower.</i>	<i>Cotton.</i>	<i>Maize.</i>	<i>Soya.</i>	<i>Diff. req. for Significance.</i>	
389	321	318	272	237	157	P = .05 72	P = .01 97

Loam Soil. Sub-experiment A.—The other field of the Loam Rotation Experiment was under the six rotation crop treatments.

The yield on the cotton plots was very low, lack of phosphate being a possible cause, and the final yield was only 249 lbs. seed cotton per acre. The other rotation crops, though less well grown than the previous year, did not seem to be suffering from any deficiency. Maize and sunflowers in particular gave good crops. It is possible that the beneficial effect of fallow is partly due to the lesser drain of phosphate on the fallow plots, and the addition of phosphate to the whole field this year should throw further light on this point.

Deep soil moisture samples were taken on the rotation crops towards the end of September, samples being taken at intervals of one foot, from two feet down to five feet. The mean of these four depths showed teparies to have the greatest reserve of sub-soil moisture, with an average of 19.02%. Tepary plots were significantly moister than all other treatments except fallow. The drying effect of sunflowers on the soil moisture was again evident, the sunflower plots being significantly drier than all other treatments, the average moisture content being 16.28% compared with 18.23% on the cotton plots, which were the next driest.

Granite Soil.—Sub-experiment B was planted with 052 cotton on October 28th, 1935, but was destroyed by a dust storm a month later and replanted on December 9th.

Plant samples were taken during the season, but no significant differences were found, while the differences in total yields of seed cotton, though fallow was again in the lead, were also not significant. The average yield for the experiment was 702 lbs. seed cotton per acre.

Sub-experiment A was under the six rotation crop treatments, all of which made fair growth.

Potash—Nitrogen Experiment.—The object of this experiment was to see if increasing applications of nitrogen would decrease the net assimilation rate, and so the growth and ultimate yield

of cotton, when without potash, but would increase it with sufficient potash.

The experiment was laid down this year, for the first time, on a field of uniform fertility following a crop of teparies. Superphosphate was applied over the whole area before planting at the rate of 200 lbs. per acre.

The experimental area consisted of seven blocks, each block having nine different treatments, these being N_0 , N_1 and N_2 combined in all possible combinations with K_0 , K_1 and K_2 . The dressings 0, 1 and 2 being respectively nil, 200 lbs. and 400 lbs. per acre with each fertilizer.

The potash and nitrogen were both applied on October 23rd, 1935, and the field was hand planted with 920 S.B. cotton on December 23rd.

Germination was good and rapid and the whole field made excellent growth. Plant samples were taken at intervals throughout the season, but no treatment effect was noticeable, the field being one of the most uniform in appearance on the whole farm.

Picking continued until August 3rd, and the average yield for the whole experiment was 1,024 lbs. per acre seed cotton. The experimental result was not significant and there was no evidence of any treatment effect at all.

The experiment is to be continued for another year, when the nitrogen will be applied as a top dressing after the cotton has germinated. It is felt that some of the effect of the nitrogen may have been lost in the past season through the early application, as 4.21 inches of rain fell between the time of its application and the date of planting.

ROTATION CROPS.

BY

M. F. ROSE.

General.—In spite of the lateness of the season all crops made good headway in their early stages of growth, and although the yield figures for maize and beans did not show as good a return as in the previous season, fair yields were obtained in all sections: the first maize plantings—both bulk and variety trials—were later by at least five weeks than the normal date, coinciding with that of a second planting in an ordinary season. Although rains fell during the tasselling and silking phase of both plantings, a drought spell in early March must have reduced yields considerably. Tepary and soya beans were adversely affected by this drought and their harvesting was seriously

hampered by successive rains at the end of March; the grain quality was consequently below standard. For the first time in the history of tepary beans at the Station, a severe eel-worm attack was recorded on the granite soil.

All sunflower lots yielded well, and with the high prices ruling at the time, proved a profitable crop.

Maize.—Owing to the season, no early maize trial was laid down on the loam: the mid-season and late trials (loam) were planted on December 23rd and January 15th respectively: the inter-row spacing was constant at 36 ins. The yield figures are given below.

Yield (lbs. per acre).

Dec. 23rd.					Jan. 15th.				
Anveld	18"	...	...	2,750	Peruvian	12"	...	1,538	
"	24"	...	...	2,557	"	18"	...	1,654	
"	36"	...	...	2,092	Anveld	18"	...	2,208	
Hickory	18"	...	...	2,429	"	24"	...	1,838	
"	24"	...	...	2,270	"	36"	...	1,633	
"	36"	...	...	1,916	Morgenster Marvel	18"	...	2,238	
A. W. Flint	18"	...	...	2,467	"	24"	...	2,222	
"	24"	...	...	2,292	"	36"	...	1,716	
Morgenster Marvel	18"	...	...	2,709	A. W. Flint	18"	...	2,130	
"	24"	...	...	2,630	"	24"	...	1,997	
Difference required for P=.05, 303 lbs.					Difference required for P=.05, 307 lbs.				

The late-planted (Jan. 16th) variety trial on the granite yielded the following results:—

Strain.					Yield (lbs. per acre).				
Peruvian	12"	...	...	...	1,072				
"	18"	...	...	...	1,303				
Anveld	18"	...	...	...	992				
Morgenster Marvel	18"	...	...	...	1,081				
A. W. Flint	18"	...	...	...	1,299				

Results non-significant.

Morgenster Marvel, a reputed cross between American White Flint and Wisconsin and obtained from the Northern Transvaal, replaced Potchefstroom Pearl in all trials: no bulk plantings have been made of this cross which is purely in the experimental stage.

Bulk Field Returns

- (1) Hickory: 1,473 lbs. per acre off an area of 4.6 acres.
 (2) Flint: 2,063 " " " " 13.0 "
 (3) Peruvian: 1,522 " " " " 2.13 "

The Incidence of "Streak" Disease.—Unfortunately for the selection work and selfing programme at the Station, practically no Streak was in evidence during the past season: on April 1st, counts were made on a planting (December 30th) of Flint, Hickory, Anveld and Morgenster Marvel; the figures showed an infection of 2%. Figures from the season 1934-35 (planting date January 7th, counted March 25th) showed an infection of 80%. However, of the 400 lots of selfed lines planted, 350 were eventually discarded on such points as chlorophyll deficiency, profuse tillering, weakness of straw, rust susceptibility, etc., leaving on hand 50 excellent lots; from these, 710 "selfs" were

obtained. The possibility of a late streak attack was anticipated and provision was made against this contingency by having two plantings of each lot—one mid-season, one late. The late planted lots of January 15th showed practically no infection, so as a guide to the discarding of susceptible non-infected lots of the first planting (December 24th) they were of little use: a small plot (March planted) of American White Flint was badly streaked, but the plants were stunted and yielded no crop.

Twelve backcrosses (Hickory ♂ Peruvian ♀) × Hickory ♂ and (American White Flint ♂ Peruvian ♀) × American White Flint ♂ were made: eleven lots are on hand for planting in the coming season.

Maize Fertilizer: heavy phosphate versus nil.—Figures for the first year of this experiment (which extends over two years) are given below. In the coming season better germination values, stronger growth, the possibility of a greater resistance to “streak,” and a higher final yield are expected in the grain from the heavy fertilized plots.

Phosphate applied October 25th (superphosphate at 750 lbs. per acre).
Hickory planted December 24th.
Heavy Phosphate = 1,890 lbs. per acre.
Nil = 1,006 lbs. per acre.
Difference required for P = .01, 816 lbs.

With regard to seed weight, there was a significant difference in favour of grain from the heavily dressed plots.

Tepary Beans.—The season 1934–35 marked the discontinuance of the two-dimensional spacing trials: data and conclusions are given in the Progress report of that season.

The possibility of broadcasting a thick cover of beans directly on the “plough,” and harrowing to cover was a direct outcome of the results obtained, for these beans seem tolerant of a very close inter-row, inter-plant spacing with no consequent reduction in seed weight or yield.

The experiment “Broadcasting” versus “Drilled” was designed to test broadcasting against the standard drill spacing of 2 ft. 8 ins. between rows and 2 ins. between plants.

Two trials were laid down, one on the loam and one on the granite soil. Ideal conditions were obtained on the loam, the broadcast plots coming away well, but on the granite the drying-out of the surface soil was much quicker, causing a poor, patchy stand with much subsequent weed growth: this practical aspect of broadcasting on a light, puffy soil must not be disregarded. Unfortunately the granite trial was ruined by a severe eel-worm attack and no figures were obtained, but judging by the stand on the two treatments, there can be but little doubt that the “Drilled” would have far outyielded the “Broadcast” plots.

The loam figures (planting date January 16th) are given below :—

Area per plant.	Yield per acre (lbs.).
Broadcast, 32 sq. ins.	1,153
Drilled, 64 sq. ins.	1,015

Difference required for P = .01, 92 lbs.

The trial will be repeated on both soil types in the coming season.

Tepary Fertilizer. Residual effect.—An experiment with tepary beans—1 ft. 9 ins. between rows and 2 ins. between plants—was superimposed on the permanent cotton fertilizer field: during the season 1934–35 the cotton had received the following treatments :—

- (1) P₃ (superphosphate 500 lbs. per acre).
- (2) P₁ (superphosphate 250 lbs. per acre).
- (3) K (sulphate of potash 200 lbs. per acre).
- (4) K.P.N. (sulphate of potash 200 lbs. per acre plus super. 250 lbs. per acre plus NaNO₃, 200 lbs. per acre).
- (5) Nil.

The trial, planted on January 17th, gave the following results :—

Treatment.	Yield (lbs. per acre).
P ₃	1,084
K.P.N.	952
P	914
K	511
Nil	476

Difference required for P = .05, 103 lbs.

Sunflowers.—Bulk lots of St3 and B4 with special bulk lots selected from them were carried on during the past season: St3 SE, the early selection from St3 BK, was tested out against the latter. The yield figures are shown below :—

Strain.	Yield (lbs. per acre).
St3 BK—18"	1,645
24"	1,535
St3 SE 18"	1,212
24"	1,220

Difference required for P = .05, 244 lbs.

The trial was planted on December 31st at a constant inter-row spacing of 36 ins.

The yield figures for St3 SE are disappointing; in spite of its earliness (approximately 1 month earlier than the parent strain) uniformity in ripening off and "non-shattering" power, it will be discarded eventually if the yield figure cannot be raised by selection.

Miscellaneous lots.—Eight lots of soya beans, selections from Barberton Yellow 1 and Mammoth, were grown in observation plots together with 4 lots introduced from China. The Chinese lots afforded interesting types, but nothing of outstanding merit; their relative shattering period was shorter than that of the Barberton strains.

Three lots of groundnuts (Sch. 21, Halle and Talkan) from the Dutch East Indies were also kept under observation. The planting date was December 31st and it was hoped that differences in "rosette" resistance might have been seen. However, no rosette was seen in

any of the lots, nor in the Barberton strain growing alongside. The seed of the three lots was large and attractive but the maturation period was 1 month longer than that of "Barberton."

A planting of the Barberton strain of groundnut on a local farm yielded over 1,800 lbs. of nuts per acre, approximately 1,300 lbs. of decorticated nuts.

INSECT PEST WORK.

1. INVESTIGATIONS ON THE AMERICAN AND RED BOLLWORMS.

BY

F. S. PARSONS AND J. MARSHALL.

AMERICAN BOLLWORM.

Infestation Records.—As reported last year, a reduction of bollworm attributed to virus disease was experienced in the summer of 1935. There was possibly some reflection of this when bollworm activity recommenced in the succeeding winter crops: although, as usual, the periodicity of breeding was similar, the August–September oviposition on the indicator farms was barely one fifth of that in the corresponding period of 1934. The egg-laying at this time of year is concentrated largely on peas and is due entirely to moths emerging from pupæ formed in the latter part of the preceding summer. As noted later in recent studies of mortality on various food crops, the survival of pea-bred larvæ is relatively high, and the amount of egg-laying on this crop is thus a fair indication of the actual moth production in our winter breeding areas; on this occasion the production was lowered.

The egg-laying on winter crops was finished in the first part of November. As the rains were very late, there were on most farms no food crops and very little weed growth to serve as breeding sites from November to February. In consequence the summer bollworm attack did not occur until March and was not extensive, except at points where ratoon cotton was rather better grown, or where early maize and weeds were germinated by irrigation: a few centres of this description served to maintain the bollworm, and localized attacks of some severity were recorded there upon flowering of the principal crops.

At all points of recording here, in Swaziland, and in Zululand the summer oviposition was almost exclusively on maize.

The rôle of weeds as alternative food plants in the period intervening between winter and summer crops has been examined to some extent. Weeds produced in irrigated plots and left undisturbed after the crop is off are particularly important breeding grounds, as the following figures indicate. In a five-acre patch 258,000 natural food plants were counted: these consisted mainly of *Physalis* spp., but two species of *Datura* and a burrweed were well represented. Larval survival on these hosts has not been computed, but according to

records on sampled areas approximately $4\frac{1}{2}$ million eggs were deposited on these weeds within a period of five weeks.

Following the very light infestation of the summer, the present winter breeding is found to be the smallest recorded in five years. Owing to early and abundant rains, however, summer crops and weeds are expected to follow on immediately afterwards, thus providing conditions that may lead to a heavy multiplication of bollworm.

Alternative Food Crops.—Attention was given to the relative attractiveness of chick pea (*Cicer arietinum*), *Dolichos lablab*, groundnuts, broom corn, castor, sword and mung beans grown in serial plantings with cotton and maize, large plots being set out in randomized block experiments. This, as mentioned previously, represented preliminary attempts to discover a substitute for maize as a counter attractant. The light infestation precluded satisfactory tests, but the chick pea plots received throughout a particularly large preponderance of all the egg-laying and it was observed that larvæ migrated to this crop from other food plants. Rekatch* states that in Armenia *Cicer arietinum* served to divert the moth from cotton and there are several references from points in Africa and Madagascar to the same effect. Although it is not perhaps a suitable crop, even on a small scale, for European cotton-farming, a study of its utility from the bollworm point of view may prove of value elsewhere in Africa where cotton is grown by natives. The tests are accordingly being extended. Two strains of chick pea have been grown which appear to differ markedly in the bollworm relationship. Selections have been taken in these and a number of other strains have been procured from India. Although the pea is grown commonly as a winter crop, for example in Nyasaland, it progressed fairly well under both summer and winter conditions at Barberton.

Reference may be made here to an investigation of the question whether, as commonly assumed, maize breeds more bollworm than cotton. The grounds on which the assumption is based are not clear, but differences in the rate of larval development in one case might lead to a more rapid multiplication than in another; another factor might be increased sizes and weights of larvæ and pupæ, due to extra nutritional factors in, for example, maize, leading to larger moths with increased fecundity. The following conclusions may be reported:—

* Preliminary communication on the Study of the Cotton Moth, *Chloridea obsoleta* F. during 1929, Cotton Industry, Tashkent. Vol. IX, part 9, pp. 1079-1098, 1930. (in Russian).

Larval Development.—Maize-bred larvæ make weight more rapidly than cotton-bred larvæ and the duration of the earlier stadia is reduced somewhat. There was, however, no significant difference between the mean periods, hatching to pupation.

Pupal Stage.—There was no significant difference between the mean duration of the pupal stage or between the mean size and weight of pupæ from both sources, size and weight of pupæ being very highly correlated, as $r = .9920$ with $P < .01$.

Moth.—Weight of moths was according to weight of pupæ, the coefficient of correlation being $r = .9071$ with $P < .01$.

No differences in the rate of development and size relationship were found. As regards fecundity, egg production (including formed eggs found in moths on dissection after death) was correlated with moth weight and size, but the mean number of eggs produced by maize-bred moths (1720) was significantly greater than those produced by cotton-bred moths (1585). This appears to be an expression of differences in nutrition during larval life. It might be argued from this that maize breeds more bollworm, but here the question of larval survival comes in. Our data from routine records of comparative oviposition and larval counts on both crops clearly indicate that mortality on maize in both egg and larval stages is consistently much greater than on cotton: this aspect of the study is being subjected, however, to a more comprehensive analysis and the full details will be published later.

Factors in the Development of Infestations.—The annual march of bollworm and the attraction of moths to crops are well presented by the oviposition records as taken. Appreciation of other factors becomes necessary to evaluate the part played by individual crops as breeding areas, particularly those preceding cotton and other summer crops, as here we are concerned with the production of *moths*, those giving rise to what may be termed the first summer generation. The following factors have been investigated intensively in part:—

- (1) The course of egg-laying, rate of larval development and mortality on all the winter food crops. On the evidence obtained there is apparently a very considerable and habitual difference in the duration of larval life on various food crops independently of temperatures, and mortality varies enormously.

Many of the vegetable and orchard crops that are most heavily laid upon are relatively unimportant in terms of moth production and in this respect distinctions must be drawn between the winter food crops of the bollworm by studies of mortality in the post egg periods. Peas may be cited as prime sources of moth production because we learn there is a high survival to the moth stage over large acreages of this crop.

- (2) In conjunction with (1) a study has been made concerning the flowering curve and associated egg-laying on the individual crops together with the growth-development of fruit material: differences in the flowering habit, the rate of provision and

condition of food for the larval progeny have, therefore, come under review and feeding experiments founded on this information have suggested reasons for the varying life and mortality found in parallel field experiments, but further work is required before any conclusions may be advanced.

Dusting Experiments.—In view of the light infestation, tests of insecticides on summer crops were postponed.

As winter peas appear to occupy an important place in the breeding cycle, these were dusted experimentally with calcium arsenate and cryolite. The results from two preliminary experiments are given in the following Table. Of late years a few growers have adopted a dusting schedule for winter crops and it is believed that insecticides would be applied by many more if the value and economy of such measures could be demonstrated. In the Barberton area the grower of vegetables is generally also a cotton grower, and having regard to the breeding developments in the former crops, some relief of summer bollworm in cotton might be expected to follow from winter dusting, and the evidence obtained from consideration of the factors should aid in formulating a dusting programme. The investigation is of local importance because of the irrigation and marketing facilities that have brought winter-cropping into being here. Information on the subject should, however, be of service ultimately in the Pongola Settlements and probably elsewhere.

RECORDS OF EGGS AND LARVÆ ON DUSTED CROPS
(expressed in numbers per acre).

(1) <i>Treatment.</i>	(2) <i>Eggs Recorded.</i>	(3) <i>Larvæ attaining 5th and 6th instars.</i>	<i>Column (3) as % of Column (2).</i>
<i>Expt. I.—One Application of Dust.</i>			
Cryolite	220,870	1,950	0.88%
Arsenate	174,970	6,370	3.64%
Normal (control)	276,510	18,590	6.72%
<i>Expt. II.—Two Applications of Dust.</i>			
Arsenate	308,200	200	0.06%
Cryolite	260,600	1,000	0.38%
Normal (control)	244,200	9,600	3.89%

The greater efficiency of the dust in Experiment II as well as the lower normal survival are attributable partly to smaller plants providing less cover in this crop.

The returns in the Table are taken from continuous analyses of larval progression to the 5th and 6th stadia from running totals of eggs over the entire course of oviposition: some pupation in the 5th and confusion of 5th and 6th necessitated adding these stages together.

The results are quite promising, especially from Experiment II where a second application was used to cover the increasing

plant surface. The work will be expanded in co-operation with farmers.

The Flowering-Oviposition Relationship and Attractive Principles.—The individual egg-laying curve of the moth follows many and irregular courses, rarely, if ever, conforming to the shape of an oviposition curve on flowering food crops. Similarly, the curve of additive oviposition by all the female moths emerging to form a distinct flight (or generation) does not conform in shape or time with the oviposition on different crops; rather the laying is spread over the period on different crops according to the duration of their flowering and relative attractiveness: actually the peaks of laying correspond very closely with the peaks of flowering and it may be postulated that increased numbers of laying moths are present in response to maximum attraction. The question as to whether olfactory perception is involved in this relationship has received considerable attention by tests of the oviposition response of moths to substances treated with the oily volatile constituents of steam distillates and alcohol-ether extracts from maize tassels and various other flowers. The non-oily volatile constituents in separated portions of the residues were tested similarly. In addition, the method of impregnating beef fat freed of glycerol with the natural odours of flowers was employed.

Filip'ev* has reported that *Heliothis* moths laid on cotton wool treated with the acetone-ether extract from maize silk. In the present work the senior author obtained instances of exclusive oviposition by caged moths on wool and other substances moistened with essential oil distillates and extractions, but the results from continued tests were contradictory, there being evidence of the intervention of food and sex responses necessitating investigation of these factors separately. Preparatory to further work on attraction, the feeding habits of the moth are being studied using a nectar prepared from the results of a complete analysis made here of the constitution of nectar collected from cotton flowers.

Whatever the circumstances may be that evoke recognition by the female of the flowering condition, it is perhaps significant that the developed fruit, particularly developed ovules, plays an important, if not, in some cases, an essential part in larval growth. Generally speaking, the oviposition is *timed* so that growth of fruit bodies and larvæ are adequately parallel, but as implied in an earlier paragraph, there appear to be exceptions to the timeliness of growth of the fruit that lead to extra high mortality.

* Filip'ev (I.N.). Ann. Rep. St. Inst. Exptl. Agron., 1928-29, pp. 168-198 (In Russian). R.A.E. Series "A," Vol. XVIII, 1930, pp. 606-607.

RED BOLLWORM.

Infestation Records.—It has been established definitely that ratoon and other standover cotton are responsible for the increasing incidence of red bollworm at Barberton. Despite advices to the contrary, ratooning is practised now by many growers, the ratios of ratooned to plant cotton in the past three years being for 1933–34—1 : 24, 1934–35—1 : 15 and 1935–36—1 : 4. Our evidence on the course of moth emergence from carry-over pupæ, breeding and multiplication in the immediately available ratoon and other standover cotton (unduly late destruction of plant cotton is included) clearly indicates a process of wholesale fostering of red bollworm before plant cotton is well advanced in growth. The ratoon-bollworm association has, however, been reported on other occasions. Local farmers have now applied to the Government for a compulsory close season.

Field Survey Work.—A full year's records are now available from the St. Phillip's post, Swaziland, on the association of the bollworm with the natural food plants, *Cienfugosia Hildebrandtii* and *Gossypium herbaceum* var. *Africana*. Mr. Hutchinson was able to complete an onerous programme with the help of exceptional native recorders.

Cienfugosia bred red bollworm continuously from September to June in certain favoured situations and from October to May in vleis locations, wild cotton from November to June. The life cycle on both food plants differed little, and is not dissimilar to that on cultivated cotton. By virtue of its earlier fruiting *Cienfugosia* offers sustenance to the progeny of the earliest emerging moths and practically breeds one generation before wild cotton bears food material for the support of larvæ. There was a continuous supply of green capsules for nine months in the first, and eight months in the second case : these were increasingly heavily infested and, apart from the earlier start, the seasonal trend of the attack was the same as is experienced in cotton crops at Barberton. Evidently if ratoon is present, whether or not in a natural food plant region, it fulfils the part of the natural hosts in giving earlier and, because of its acreage, ampler pre-multiplication of the bollworm.

Where comparable figures were available, they showed that eggs were laid more heavily on wild cotton, once it engaged the attention of moths, but the survival ratio appears to be lower and there may be little to choose between them individually as sources of infestation ; *Cienfugosia* plants are, however, as noted below, much more numerous.

One of the objects of this work is to study the possibilities of evading the bollworm by growing out-of-season cotton where practicable. The situation revealed does not augur well for early and

partially out-of-season cotton in the Pongola Irrigation Settlement, which is pre-eminently a home of *Cienfugosia*. On the other hand, February or early March planting may be the solution. Experimental areas for the planting trials are being set out by Mr. Bowmaker of Magut at two points under the Pongola irrigation furrow.

A study of the bionomics of the red bollworm has been undertaken at the St. Phillip's Field Station by Mr. Hutchinson.

The Distribution and Ecology of Cienfugosia Hildebrandtii and Gossypium obtusifolium.—Valuable data on these subjects were procured in a recent survey of Northern Zululand and the low velds of Swaziland and the Eastern Transvaal. The work was rewarded and greatly facilitated by the discovery of an intimate and readily remarked plant association of *Cienfugosia* with *Acacia* (? *natalitia*) and a species of *Euclea* as the principal indicators, and the habitat and distributional factors were defined clearly. The plant is confined to the low country, under 1,100 feet, and East of the granitic, somewhat rolling, country that is bounded fairly closely in this region by the parallel of Longitude 31° 30' E. It is an important fact that the country to the west of this, a better rainfall area, contains with few exceptions the present-day European cotton farmers, also the bulk of the present and potential native cotton growers. As the vegetation in this westerly, higher country has now been examined pretty thoroughly, it is practically certain that other, undiscovered, food plants are non-existent and here there is little likelihood of constant re-infestation: red bollworm *is* present, particularly at Barberton for reasons given, but under the close season regulations in Swaziland, which this fresh evidence strongly supports, the bollworm has not been a major pest, nor has the incidence varied much according to the pest survey records of the past three years.

Portions of the Magut district embrace the habitat of *Cienfugosia*, whereas for reasons connected with watersheds other portions do not. The weight of infestation has varied accordingly and the danger of fostering the insect in ratoon and standover cotton there and in similar tracts of Zululand cannot be emphasized too strongly.

In order to test a hypothesis that the plant is absent on the granite soils, the survey was extended north and north-eastward of Barberton by a rapid tour to a point near the Olifants River. *Cienfugosia* was not found on the granite soils which there intrude into the low veld, nor was it found elsewhere on other soils except for one case, a normal situation, near the confluence of the Crocodile and Komati Rivers where the extension of the survey commenced. The absence of *Cienfugosia* and associated flora on the other soil types, which in fact

are classed in a section of the Karroo System that elsewhere contains them, is explicable for reasons of which mention may be deferred.

On the score of abundance *Cienfugosia* is certainly a more potent source of red bollworm than wild cotton. The latter, although broadly co-extensive with the other food plant, appears to flourish indiscriminately.

In the event that it may be useful and practicable, methods of eradicating the plants are being investigated by Mr. Hutchinson.

II. INVESTIGATIONS ON COTTON STAINERS AND INTERNAL BOLL DISEASE.

BY

E. O. PEARSON.

During the past year recording work on wild host plants and in the crop has been carried out under Mr. Hutchinson in Swaziland and under Mr. Bowmaker in the Magut district. The writer visited the chief cotton-growing areas of Nyasaland in June and July to discuss stainer problems with workers there and made a rapid reconnaissance relating vegetation types to the distribution of stainer host plants. A short time was also spent in S. Rhodesia.

Observations on Wild Host Plants.—Continuous records of flowering, fruiting and stainer population on 145 marked trees of *Sterculia Rogersii* N.E.Br. in the Barberton, Swaziland and Ingwavuma districts are now entering their third year. It has been found that at lower altitudes the tree normally has two fruiting periods, the first and smaller crop opening rather indefinitely from June-August and the main crop in November.

The winter crop is usually accompanied by an immigration of stainers in the Ingwavuma district, but this has not been recorded in Swaziland, and in the Barberton area the winter crop is suppressed. Last season *D. intermedius* was present on the Ingwavuma trees from August to February, with the main immigration in November, at the same time as in the Barberton and Swaziland districts. Most of the crop was shed through drought, however, and practically no F_1 was matured on the trees, though, as in 1935, movement of late instar nymphs to adjacent herbaceous host plants took place in January. *D. nigrofasciatus* occurred in small numbers in the Ingwavuma district from August to December, 1935, but in the Barberton and Swaziland districts it failed to appear at all on *Sterculia Rogersii*.

Whilst it has proved difficult to extend to herbaceous hosts the precise method of recording used for *Sterculia*, it has been possible, by periodic recording on groups of plants scattered along regular beats, to obtain some picture of the fluctuations of stainer populations under natural conditions. These beats have been chosen near *Sterculia* colonies or near cotton farms where recording is being done, or along a line of country which may conveniently be traversed at regular intervals. The Barberton and Magut districts suffered a virtual drought from March to December, 1935, and perennial host plants started growth very late and made little advance before being checked by February drought; records were consequently largely negative and those obtained sparse and scattered. The late rains of May and

an early start to the present season have given, on the other hand, favourable conditions under which to study overwintering, and much new and important information has been gathered from August onwards.

In N. Swaziland, where conditions were less severe early in the season, Mr. Hutchinson obtained an excellent series of records from two particularly favourable localities on *Hibiscus calyphyllus* Cav., one of the most important and widespread hosts of *D. nigrofasciatus*. These start at the end of November with a small population of adults and nymphs, the former probably derived in part from fresh immigration. Breeding continued, with a well-marked peak in early March, until mid-July, after which the population dwindled to very small numbers in September-October, corresponding with the dying back of the plants in the warm dry season. These observations are supported by numerous records taken elsewhere. It is noteworthy that this host can support *D. nigrofasciatus* throughout the year.

Records were also obtained on several other perennial herbaceous hosts, including *H. dongolensis*, *H. vitifolius*, *H. sp.* near *H. mutatus* and *Abutilon spp.* Scattered records in the early part of the season shew breeding to have been in progress from December and later; fuller records shew that this continued until July, after which only adults were found, in dwindling numbers, until August, when the populations were practically reduced to zero. Amongst annual hosts, *H. trionum*, occurring in abandoned native lands in Swaziland, as successive weed crops near Magut and, following severe drought and overgrazing, in bushveld near Ingwavuma, carried *D. nigrofasciatus* from January until April and, in one case, July. *H. cannabinus*, occurring in similar situations but having a much longer pre-flowering period, was invaded in April, a large population being built up in May and June and small numbers still being present in August.

The results of these observations and the maintenance of those previously instituted, have convinced us that the annual stainer cycle cannot be described in terms of a regular succession of hosts varying little from one district to another, as in countries where that cycle is dominated by one or two major hosts. The range, at least for *D. nigrofasciatus*, is so wide that for a given year or a given locality a portion of it only may suffice.

Observations on D. nigrofasciatus and D. intermedius in August-October.—Records on herbaceous hosts show that following the end of the rains and the consequent cessation of growth and fruiting there is a gradual diminution of active breeding until by about July the stainer population is reduced to adults or late instar nymphs on the majority of hosts, although those in particularly favoured habitats can

sustain breeding at a low level. Much the same thing happens on cotton after the final picking. Following the break of the rains in October–November, however, fresh and active adults flight in to *Sterculia Rogersii*, early *Hibiscus spp.*, wild cotton and standover cotton in such numbers as could hardly have been derived from broods precariously overwintering on herbaceous hosts in sheltered situations.

A clue to the origin of these infestations has been found by the discovery, in August, of adult *D. nigrofasciatus* fighting to *Dombeya rotundifolia* Harv. (*Sterculiaceae*), a small tree very common on rocky hill slopes and the margins of spruits in the middle and low veld. The tree flowers abundantly in August, the small fruit ripening off in about two months time. Stainers were rarely found on trees other than those which had an abundance of blossoms, some shade either from their own leaves, which occasionally persist, or from trees overhead, and were sheltered by rising ground or thickets. Even where these conditions obtained only about a quarter of the trees examined carried any stainer.

Adults were found on the trees from mid-August until the end of September, feeding on the flower nectar and spending much of their time sheltering in crevices of the bark and below leaf debris. Nymphs were slow in making their appearance and so far as could be ascertained in the Barberton district no F_1 adults were matured until late October. As 3rd instar nymphs were present in numbers at that time the maturation of the F_1 must be spread over a long period. The August–November gap can thus be bridged by the intervention of a single generation on *Dombeya*.

Two other observations are of interest in this connection. During early September Mr. Hutchinson found adults of *D. intermedius* and *D. nigrofasciatus* on *Acacia pallens* Rolfe, one of our commonest trees, which flowers in this month. In late September, on a farm in the Barberton district, large numbers of adults and 5th instar nymphs of these species were found migrating from cotton lands to specimens of *Gymnosporia acuminata* Szysz. (*Celastraceae*), a large evergreen bush, which is common in sheltered situations along the banks of spruits, and which during September is covered in masses of small, strongly scented flowers. In neither case was a single mating pair of stainers seen nor were there any nymphs produced. Feeding was confined to the flower nectaries. On *Gymnosporia* adults were present for about a month, moving away when flowering finished. Since during August–October a large proportion of the trees in the bush are in flower such phenomena may be not uncommon, and it seems possible

that stainers may obtain sufficient sustenance from nectar to enable them to carry over these months as adults.

Records in Cotton.—Plant cotton this year was late in all districts; in Swaziland and a few farms in the Barberton district boll opening commenced at the end of March, while elsewhere it was delayed until mid-May. Late rains and cold weather from March onwards led to an abnormal amount of disease. Early defoliation by *Alternaria** occurred on many farms and much abortion, bad opening and staining of bolls was caused by *Bacterium malvacearum*, rising to as much as 47% of the total bolls on one farm. Ratoon and very early plant cotton forming its crop during the warmer and drier weather of the early part of the year, suffered much less. The infestations of stainers were extremely varied.

D. intermedius was as usual rare in the Magut district and not numerous in Swaziland. In the Barberton district the initial migrations were larger than normal and very much larger in proportion to *D. nigrofasciatus* than in previous years. These proportions agree generally with the records from wild host plants in the different districts. Evidence is accumulating on two points with regard to this species in cotton: firstly, infestations are much lower in areas from which *Sterculia Rogersii* is absent and secondly, the number of 5th instar nymphs appearing in counts usually exceeds by two to eight times the numbers of adults bred in situ, indicating a strong tendency to emigration from cotton as soon as the final moult has occurred.

Infestations of *D. nigrofasciatus* were again low in the Barberton and Magut districts. Corresponding to the small populations on wild host plants, immigrations were small, averaging less than 400 per acre, and started about three weeks prior to boll opening. Breeding was thus at first delayed and later restricted by cold weather and the poor condition of the crops, peak populations averaging only 1,000 per acre.

In Swaziland the initial migrations were fairly large, averaging 1,000 per acre and roughly coincided with boll opening; conditions were good and a big population was eventually built up. As in the previous year, however, the main breeding peaks, though rising to 12,000 adults per acre, were not reached until well after the bulk of the crop had opened. The stainer/boll ratio was thus low during the maturation of the main crop and the average degree of staining† reached 10% on one farm only and elsewhere was still lower.

* Similar in general symptoms to *Alternaria gossypina* Thum. described by Hopkins from S. Rhodesia (Trans. Brit. Mycol. Soc. XVI, 136, 1931).

† Calculated as a mean of the percentage staining recorded each week weighted by the boll opening index for the week.

These results for *D. nigrofasciatus* and *D. intermedius* are similar on the whole to those obtained for the past three years in all districts. In fact, assuming (1) that the infestations occur in the order normally recorded, (2) that they come at or shortly before boll opening, and (3) that the latter is largely completed in under two months, it seems unlikely that infestations of stainers derived from their natural food plants should ever be a serious factor in rain-grown crops of plant cotton in the areas we have under observation.

Observations on *D. fasciatus* confirm the remarks made in last year's report. It appeared in small numbers only in Swaziland and Magut districts and on those farms in the Barberton area which were unaffected by the proximity of ratoon or standover cotton. Acreages of these have risen sharply since 1934-5 and at least one clear case of overwintering of *D. fasciatus* was observed, which produced a population of 11,000 adults per acre by the end of February. The later pickings from the ratoon crop suffered accordingly and plant cotton on this and adjoining farms was damaged to such an extent that practically no crop was reaped. Sample collections over the whole district in June and July shewed a striking correlation between proportions of ratoon cotton and the proportions of *D. fasciatus* in the total stainer population on plant cotton on the different farms.

Several cases have been kept under observation from July-November, 1936, where fields have been left standing over or where cotton trash has not been destroyed and it is clear that *D. fasciatus* can and will overwinter, very much more readily than the other species, in such situations, thus maintaining itself in an area where the absence of its wild hosts should prevent it being a serious pest of plant cotton.

Experiments in the Transmission of Internal Boll Disease.—These and other experiments cannot be fully described here, but the following results may be recorded.

In experiments to determine the extent to which different stages of *D. nigrofasciatus* feed on bolls of different ages it was found that under field conditions this is apparently conditioned partly by desire for moisture and partly by desire for nutrition; early instars (2nd and 3rd) only fed on bolls up to three weeks old whilst later instars fed in bolls of all stages, but to a much greater extent on those from 2-6 weeks old. Under artificial conditions at high humidity there was far less puncturing as a whole and later instars exhibited a strong preference for older bolls. The puncturing rate in both experiments and for all boll ages was very much higher for the later instars.

Further experiments were made to find whether different instars

vary in their ability to transmit disease, and whether an individual, once infected, retains its infecting power through a moult and hence remains infected throughout its life. Nymphs bred under sterile conditions were allowed to feed on green bolls inoculated with *Nematospora gossypii* and then divided into two batches, the members of one of which were individually caged on sterile bolls which were subsequently examined for infection, the other batch being returned to sterile food and allowed to pass through the next moult before being similarly tested. No significant relationship could be determined between instar and infective power; all stages other than the 2nd successfully transmitted *Nematospora* and the failure of this instar was not significantly proved on account of unavoidably high mortality.

No significant difference could be demonstrated between *D. nigrofasciatus* and *D. intermedius* as vectors. A strongly significant difference was obtained between nymphs tested before and after moulting as described above.

	Infected.	Not Infected.	Total.
Nymphs fed on infected bolls and tested immediately	17	115	132
Nymphs fed on infected bolls and tested after a moult had intervened	1	74	75
	18	189	207

$$\chi^2 = 7.97 \quad n = 1 \quad P < .01 \quad \text{Significant.}$$

The results suggest that transmission of *Nepatospora* from boll to boll by stainer is purely mechanical, due to contamination of the mouthparts of the insect, infection not persisting from one instar to the next owing to the shedding of the exuvium during ecdysis. If there were any passage of fungus spores from the midgut to the salivary glands one would expect the nymph to remain infected throughout its life, which apparently it does not.

COTTON EXPERIMENT STATION, MAGUT, NATAL. PROGRESS REPORT FOR THE SEASON 1935-1936.

BY

P. A. BOWMAKER.

SEASON AND GENERAL.

The period March, 1935 to January, 1936, was rainless apart from isolated showers of no value. The drought conditions were the worst that have been experienced since there has been European settlement in the Magut district. Planting rains materialised in mid-January, and very excellent growing conditions followed. The already short season was brought to an abrupt end by cold weather and rains at the end of May, which stopped the development of later bolls.

As a result of the lateness of the season, and the need for hurried cultural operations subsequent to ploughing, indifferent stands and consequently poor yields were obtained from cotton in the district. Conditions, however, were excellent for the shorter period rotation crops, and fair yields of these were general.

On the Station an average of 282 lbs. to the acre of seed cotton was picked, which was considered very fair in view of the very short season.

COTTON.

Variety trials.—A number of strains which had not done well in the previous two seasons at Magut and elsewhere were dropped, and work was concentrated on tests of the major strains against each other and against their substrains which have been evolved by Mr. Parnell. Six tests were completed, the results of these being given in Table I.

In order to get as much information as possible with the labour and equipment available, a change has been made in the general layout of tests. A standard row length of 46' (*i.e.*, 24 plants) has been adopted, the number of replications has been increased to twelve, and with the exception of Trial I, which is concerned with the major strains, where four lines are used, a plot consists of two lines. The differences in yields required for significance from this layout are considered very satisfactory.

TABLE I.
Cotton Variety Trial Yields.

Strain.	Variety Trial	Lbs. of lint per acre.					
		1	2	3	4	5	6
929R		166	194	...	...	...	...
998R		153	192	...	...	...	...
951R		148	199	...	...	...	...
046		...	203	...	...	...	...
23		...	193	...	...	...	...
052		131	188	...	...	...	125
324		...	182	...	...	...	...
231		...	180	...	...	...	...
321		...	176	...	...	...	...
33		...	173	...	...	...	...
U/4/4		...	174	...	...	...	...
096		117	...	...	121	...	98
0101		115	...	...	137	131	107
386		...	...	...	...	162	...
921		110	...	123	121	...	103
234		...	151	...	...	...	...
920		105	...	113	122	125	93
0343		104	...	...	...	133	91
0342R		103	...	...	...	...	86
391		...	...	...	...	140	...
0342		...	...	...	...	137	...
395		...	...	...	...	136	...
266		...	...	...	133	...	...
387		...	...	...	...	134	...
2130		...	...	...	...	131	...
378		...	...	...	...	128	...
099		...	...	...	127	...	...
379		...	...	...	...	120	...
384		...	...	...	...	118	...
097		...	...	...	116	...	95
0270		...	...	111	...	...	96
297		...	...	110	...	...	...
0269		...	...	110	...	...	...
0267		...	...	106	...	...	...
0268		...	...	105	...	...	82
0338R		98	...	...	...	...	78
0344		96	...	...	...	125	75
Difference required for significance (P = .05)		11 lbs.	16 lbs.	13 lbs.	15 lbs.	15 lbs.	14 lbs.

The features emerging from the above yields are, as would be expected from the growth conditions, the outstanding superiority of the early strains. As was mentioned in the previous Report, in which a rather similar season was described, such a set of results is likely to bias opinion in favour of early strains, whereas a different set of weather conditions might reverse the position.

Several years have now passed, however, in which growth conditions have favoured the earlies, and for the time being only these are being issued to farmers.

As on previous occasions the results have been sent to Barberton for consideration by the Cotton Breeding Section, and it has been decided, with a few minor exceptions, that a further year of trial is necessary before the number of strains under test can be materially reduced.

Crosses from Trinidad.—Small blocks of eight strains of these crosses which have been kept on were planted, but owing to their general lateness, very poor yields of seed were taken.

Seed Multiplication.—For several years the seed used in variety tests at Magut has been locally grown, and the feeling has arisen that a certain amount of divergence in type, owing to different growth conditions, was showing itself. This would mean that Magut results would not be compatible with those from other Stations. All variety trials were planted with seed from Barberton in the season under review, and in addition one-sixth acre blocks of each strain were hand planted for seed multiplication purposes. All seed used on the Magut Station in season 1936/37 will be from this multiplication.

On the whole, satisfactory yields were taken, varying from 190 to 510 lbs. of seed cotton per acre, according to the lateness or otherwise of the strain.

Crop Rotation.—This experiment, as described in earlier reports, was continued. The land previously cropped on the randomized block basis with six rotation crops was planted to cotton, using strain 052; the yields were as shown below (Table II).

TABLE II.
Crop Rotation Experiment.

Cropping, 1934/35.										Yield, lbs. of lint per acre.
Maize	...	...	...	...	...	...	...	...	...	115
Soya (no crop)	...	...	...	...	...	...	...	...	...	103
Sunn Hemp	...	...	...	...	...	...	...	...	...	102
Groundnuts	...	...	...	...	...	...	...	...	...	101
Tepary	...	...	...	...	...	...	...	...	...	95
Sunflower	...	...	...	...	...	...	...	...	...	80
Difference required for significance ($P=0.05$)										20 lbs. of lint

Land was prepared for a continuation of the experiment. Fair yields were taken from all rotation crops.

Further reference to the low yield from land previously cropped with sunflower will be made later in the Pests and Diseases section of this report.

Spacing trials.—Two cotton spacing trials were laid out on lines precisely similar to the trials of the previous year. One, in which the strain 921 was used, was brought to a satisfactory conclusion, and gave 101 pounds of lint to the acre at the widest spacing, a yield just significantly ($P=0.05$) greater than that of the close spacing.

Green Manuring.—An area previously cropped to Sunn Hemp seed, Sunn Hemp green manure and maize on the randomized block basis was planted to the cotton strain 929R. The highest yield of 187 pounds of lint per acre was obtained from the green manure plots, but no significance attaches to the results.

PESTS AND DISEASES.

Recording work on pest populations of cotton and rotation crops was continued, the results being sent to the Insect Pest Control Section of the Barberton Station for compilation as before.

Only relatively slight infestations of Sudan and American bollworms were noted in the district and on the Station through the season. It is thought that this can be related to the long spell of drought interfering with the normal course of multiplication of the first moths to emerge from overwintering pupation, in so far as natural host plants were not present. The number of worms to reach the overwintering pupation stage in the current season was correspondingly lower, and it is felt that this is likely to have a beneficial effect as regards reduction of pest population for some time to come.

In connection with the development of cotton-growing in the Pongola valley under irrigation, and forming part of an extensive recording scheme arranged by Mr. Parsons, continuous records of egg laying by the red bollworm moth on the natural host plants *Fugosia* spp. and *Gossypium* sp. were carried out. As with other pest incidence records these were sent to Barberton for analysis.

A survey of the occurrence of these hosts, completed in the winter months, which is dealt with more fully in the Barberton report, indicates that certain very definite habitats are preferred, and that the host plants are not nearly as widespread as was previously thought. At the same time, red bollworm is likely to prove a pest of major importance in the Pongola valley, and a method of circumvention of this and of stainer (*Dysdercus* spp.) as far as possible is to be the subject of experiment there. Two isolated areas have been placed at the disposal of the Corporation for the purpose of this investigation by the Union Department of Lands, and it is proposed in the first place to plant one area in September and one in March, the latter standing over to be brought away by watering early on the following season. The two areas are distant from each other and isolated from existing cultivation. The only source of infestation is from wild host plants. The true position regarding increase in red bollworm numbers, and also certain obscure features of overwintering of stainer should emerge from this investigation after a few seasons of observation.

Little damage could be attributed to stainer in the district.

Verticillium Wilt.—It was noted in the previous report that this wilt seemed to be confined to fields which had received the addition of certain forms of vegetable matter. In the rotation experiment described earlier the low yield of cotton from land cropped previously with sunflower was attributed in some measure to the incidence of

Verticillium Wilt on these plots. It might be repeated that the experiment was of eight replications on the randomized block basis, with six different previous croppings for comparison, and the wilt was practically confined to the Sunflower plots. It has been decided to discontinue work with Sunflower as a rotation crop.

ROTATION CROPS.

Maize.—During the season under review some very good crops of maize were reaped in the district. A bulk of American White Flint grown on the Station, planted on various dates between 15th January and 3rd February gave an average yield of 1,650 lbs. of grain to the acre.

Single plant selection work was continued, the procedure adopted being the same as that used in previous years. As regards selection for drought resistance, the primary object of the work, little progress can be reported, but a further weeding out of strains showing certain undesirable characters was made, and a large number of single plants taken for further observation.

It is thought that part of the value of the American White Flint variety originally used lay in its hybrid make-up, and an effort was made to reintroduce hybrid vigour on a commercial seed production scale, which has given useful results elsewhere. Two strains, unrelated but similar in many characters, were interplanted and all male inflorescences removed from one. A fair quantity of seed was obtained from this and from a reciprocal cross made in a distant field.

Some small bulks taken from the single plant lots of the previous season showed very promising material.

Tepary Bean.—A close spacing as a result of previous experiment has been adopted for this crop. A field planted on 21st January was threshed on 18th April, and gave a yield of 1,270 lbs. per acre.

Groundnuts.—Owing to bad germination of one strain, the variety test of Natal, Spanish 9, and Barborton varieties had to be abandoned. Yields from seed multiplication areas planted 30th January gave an average of 1,590 lbs. of unshelled nuts to the acre.

An experiment "Ridge versus Flat Cultivation" gave an increase in yield for the latter, but it was not statistically significant.

Sorghums.—All strains of Kaffir corn which have been planted on the Station appear to be so liable to complete failure owing to aphid attack, that for some years this crop has not been grown. It was decided, owing to the steep slope and liability to wash of one field on the Station, to allow this to go back to natural veld, as was done some years previously with other sloping fields. Kaffir corn was planted at a heavy seed rate (18 pounds per acre), as it forms a very solid root

system able to hold the soil pending the establishment of natural grasses. During growth two very heavy attacks of aphid were cleared up by syrphid fly larvae, and the resulting crop was over 1,800 pounds to the acre.

A field was planted on 13th January to the forage sorghum known locally as Mapira, and gave a crop of 16 tons per acre, cut at the flowering stage on 20th April.

COTTON EXPERIMENT STATION, MAGUT, NATAL.

DAILY RAINFALL, SEASON 1935/36.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
1	...	...	...	...	·14	...	...	...
2	...	...	...	...	·30	...	...	...
3	...	...	...	...	...	...	...	...
4	...	...	...	...	·02	...	...	...
5	·20	...	...	...	·23	...	...	...
6	·04	...	...	...	...	...	...	...
7	...	...	...	...	·02	...	...	...
8	...	·15	...	...	...	...	...	...
9	...	...	...	...	·07	...	...	...
10	...	·10	...	...	·34	...	...	...
11	...	...	·10	1·34	...	...	·40	...
12	...	...	...	·90	...	...	...	...
13	...	...	...	...	...	...	...	...
14	...	...	...	...	...	...	·05	·02
15	...	...	...	...	...	...	...	...
16	...	...	...	·08	...	...	...	...
17	...	...	·23	...	...	...	...	·18
18	...	...	...	...	·05	...	...	...
19	...	...	·47	2·20	·07	...	...	...
20	...	...	...	...	·15	...	...	...
21	...	...	...	...	...	...	...	...
22	...	...	...	...	...	·54	...	...
23	...	...	...	...	...	...	...	·60
24	·60	...	...	...	·07	·72	...	1·26
25	...	...	...	...	...	...	...	...
26	·28	·13	...	...	...	·28	...	...
27	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...
29	...	...	...	·54	1·72	...	...	...
30	...	...	...	...	...	·49	...	...
31	...	...	...	1·33	...	·40	...	...
	1·12	0·38	0·80	6·39	3·18	2·43	0·45	2·06

Total = 16·81 inches.

SWAZILAND

COTTON EXPERIMENT STATIONS, BREMERSDORP AND INGWAVUMA.

PROGRESS REPORT FOR THE SEASON 1935-36.

BY

J. V. LOCHRIE.

SEASON AND GENERAL.

At Bremersdorp.—The season was short and not particularly favourable to cotton as early rainfall was slight and temperatures were low in the latter part of the season. The chief features were (a) very low rainfall to establish the crop, (b) excessive rain and cloudiness in January which retarded development, (c) low temperatures from April onwards which reduced the later pickings and (d) very slight damage by insect pests.

There was a good fall of rain on October 24th and the cotton planted at that time gave fair yields averaging 900 lbs. seed cotton per acre. The later planted cotton was much poorer and yields were low for this Station. Stands were good and the crop just managed to carry on until the ample rains of late December relieved the position. The early planted cotton in particular made good growth in the warm weather following the late December rains, but the wet and cloudy conditions in the latter part of January reduced the flowering rate. February was dry and warm and with freedom from bollworm damage the crop came on well. The early pickings were excellent, but by late April the weather became unseasonably cold and later pickings were light. The total rainfall for the season was 33·64 inches.

Bollworm damage was slight though a few Red bollworm larvæ could be found throughout the season. The situation with regard to American bollworm was interesting and amply demonstrated the protection afforded to cotton by the wide range of crops and planting dates. The Station cotton suffered no appreciable damage, while an adjoining field of kaffir corn was heavily attacked. On the other hand, a field of cotton some distance off and not protected in this way showed fairly heavy damage.

Though there was considerable migration of stainer to the crop in April and subsequent heavy breeding, little staining was attributable to the pest. The bulk of the staining was due to bacterial bollrot, the

causal organism of which had developed during the wet and cloudy weather in January.

At Ingwavuma.—The rains were very late and cotton could not be planted until January 12th. Following this late start the crop had excellent conditions and, with freedom from insect damage in the early stages, the prospects were good. Heavy American bollworm attack in late May reduced the crop and, as at Bremersdorp, owing to the cold weather towards the end of the season practically all the yield was obtained from the early picking. Despite the short season the crop gave over 700 lbs. seed cotton per acre. The total rainfall was 18·80 inches.

COTTON.

Selections.—In previous reports reference has been made to the selections from material supplied by Dr. Harland. A number of these had already been discarded on account of jassid susceptibility and as being too late for this area. The surviving material was planted this year, but owing to the poor season little further progress was made. A further number of strains showed some susceptibility to jassid in a season when the U.4 strains were unaffected. In general the most promising were those derived from the (U.4×Cambodia)×U.4 group.

Variety Trials.—A considerable number of strains derived from U.4 were tested both at Bremersdorp and at Ingwavuma.

(a) *Bremersdorp.*—These trials were planted early and had the best conditions of the Station cotton. In spite of the cold weather towards the end of the season the yields averaged 900 lbs. seed-cotton per acre. The main features of the trials were : (1) the success, as in the previous season at Bremersdorp, of the more robust of the early strains such as 052, 046, 234 and 998 ; (2) the fact that 929 which is early, but of less strong growth, did not stand up too well ; (3) that of the later maturing strains the selections from the 921 family were most generally successful, with one of the 920 lots good and all better than the 9264 family. In general these findings follow those of the previous season.

(b) *Ingwavuma.*—The experiments were duplicated at this station and, though planting was late, the crop had good conditions and comparative freedom from bollworm during the first half of the season. As at Bremersdorp the season was shortened by the fall in temperatures in early autumn and further still at Ingwavuma by the heavy American bollworm damage in late May. Practically all crop reaped was from the first picking in July. The main features were : (1) the general success of the early strains, this as in previous seasons being more marked than at Bremersdorp ; (2) as at Bremersdorp the 921 family,

particularly strain 0101, was the best of the later maturing types, with the 9624 family the least promising.

In the report of the previous season the importance of the good performance of the early strains was emphasised especially in areas where the season is likely to be short. The present season has been a short one due to late planting rains and low autumn temperatures and the early maturing types have demonstrated their value.

Green-manuring experiment.—The experiment was planted at Bremersdorp following a range of crops ploughed under in the previous season. The series consisted of sunnhemp, cowpeas, soya beans, bulrush millet and kaffir corn, the last being included on account of its established beneficial effect on the control of the Witchweed parasite of cereal crops. The amounts of green crop ploughed under varied from bulrush millet, easily highest, to soya lowest, with sunnhemp and kaffir corn intermediate. The winter and spring following was dry and only the soya and cowpeas had thoroughly decomposed by planting time. The bulrush millet plots in particular showed a considerable amount of undecomposed matter and gave a rough tilth. The results were as follows: (1) Cotton following sunnhemp always looked best and yielded significantly higher than all others. (2) Cotton following kaffir corn and bulrush millet gave significantly higher yields than that after soya. (3) Growth poorest following soya.

Spacing.—At Ingwavuma an experiment was carried out on lines similar to those described in previous reports. A standard row width of 3 ft. was used and the row spacings ranged from 1 ft. to 3 ft., the latter having an additional series with 3 plants per hole. The trial, though late, was planted under good conditions, but suffered in the latter part of the season from American bollworm damage and from the early drop in temperatures. The results showed that: (1) the 18 inch spacing was significantly higher yielding than all others and (2) the 12 inch and 36 inch (3 plants) spacings were significantly higher than the wide spacing of 36 inch with one plant per hole.

Fertilizer effect.—At Bremersdorp the fertilizer experiment described in previous reports was planted to cotton in the present year. The treatments were kraal manure alone (KM), with added phosphate (KMP), phosphate alone (P) and with potash (PK), potash alone (K) and an unfertilized series (Nil). Planting was late for this area and yields were fairly low. Though the crop was not so good as on the earlier planted parts of the station, the treatment effects were considerable; the KMP series being outstanding in growth and development. The chief features were:—(1) the beneficial effect of KM during the season; (2) KMP, PK, KM and P yielded in that

order and were all significantly higher than K or Nil with KMP superior to all; (3) K yielded higher than Nil and PK significantly higher than P. This beneficial effect of potash on cotton was noted in the same experiment two seasons ago, but on maize on the same site last year it was found that applications of potash had a significantly depressing effect on the growth and yield.

With this exception the results corroborated those of previous years both on maize and cotton.

A similar experiment at the Ingwavuma station gave no conclusive results.

Rotation effect.—An experiment was carried out at Bremersdorp to ascertain the effect of previous cropping on a succeeding cotton crop. The crops under trial were maize, groundnuts, soyas harvested for grain, soyas ploughed under, and cotton. The plants following cotton yielded little as an attack of beetle (*Syagrus rugifrons*) reduced the stand. The test shows that under this season's conditions (1) groundnuts was a better rotation crop than soya beans; (2) cotton following soyas ploughed under made slow growth and yielded little more than that following soyas harvested; (3) cotton following maize was better than that after soyas.

ROTATION CROPS.

Kaffir corn.—Selection work was continued on the early maturing dwarf types which have shown up so well during the past two seasons, and a number of promising strains are now available for comparative trials in the coming season. In preliminary trials at both stations these strains did very well and the yields were high compared with those from the seed in general cultivation in the country. The success of this dwarf early type has been so pronounced that it was decided to bulk up seed for general distribution in the native areas. Good yields were obtained from the bulking areas and approximately 200 bags of seed will be available for issue in the coming year.

Fertilizer effect.—An experiment was carried out at Ingwavuma using a bulk of the early dwarf strains with the following fertilizer treatments: kraal manure alone (KM) and with phosphate (KMP); phosphate alone (P), potash alone (K) and unmanured (Nil). The average yield was good—2,000 lbs. per acre—and KMP, P and KM were all significantly better than K or Nil between which there was no difference.

In the main these results follow those obtained in similar tests with cereals at Bremersdorp.

Maize.—As described in previous reports the dent varieties—

Hickory King and Anveld—have proved suitable for cultivation in the higher rainfall areas. Consequently work is now confined to the flint types as these have shown up well under the more trying conditions of climate and cultivation in the low veld native areas. Strains of these types are now available and are being issued to growers.

Green manure effect.—An experiment with maize was carried out, similar to that with cotton described above. As with cotton, the maize following sunnhemp was outstanding. With regard to the other treatments, the results differed from those obtained in the cotton experiment as the maize following cowpeas, and to a lesser degree soyas, showed up better than that following kaffir corn and bulrush millet.

Spacing.—An experiment using white flint maize was carried out on the low veld station at Ingwavuma. The spacings under trial were 1 plant per hole at 12 inches and at 24 inches, and 2 plants per hole at 36 inches. Conditions were good and the crop was an excellent one for this area. The close spacing of 12 inches was too cramped even for the fairly good conditions and was significantly lower yielding than the wider spacings, between which there was no difference.

Residual rotation effect.—Bremersdorp this season saw the 4th year of maize cropping following a range of crops, as described in previous reports. Up to and including the 3rd season the beneficial effects of sunnhemp and buckwheat ploughed in, and to a lesser extent that of bare fallow, were apparent in the growth and yield of maize. In the present season these treatment effects have disappeared, the yields from all treatments being practically the same.

The experiment was designed also for Witchweed observation and control and after 4 years hand picking of witchweed the area is practically free from the parasite.

Groundnuts.—Selection work was continued and trials on the lines of previous years were planted. The crop had favourable conditions for germination and in the early growing period, but later conditions were far from favourable and yields and shelling percentages were lower than in previous seasons. The main features of the trials were (1) the success as in the previous season of the new strains, Br.2 and Br.1 compared with Spanish and Barberton; (2) the good performance of some re-selections from the Br. 2 strain; (3) freedom from Rosette disease.

Beans.—For reasons mentioned in earlier reports, experimental work on beans has been discontinued, but plots of the more successful lots are being planted in order to maintain the seed stocks. The most promising have been soyas, cowpeas and tepary, the latter being a useful addition to the native food crops.

SOUTHERN RHODESIA

COTTON-BREEDING STATION, GATOOMA.

PROGRESS REPORT FOR THE SEASON 1935-36.

BY
A. H. MCKINSTRY AND A. N. PRENTICE.

SEASON.

On the Station at Gatooma, the latest planting rains on record over a period of twelve years, coupled with a drought of over two weeks after planting, gave the worst conditions so far experienced for the start of a season. The first rains for planting did not fall until the third week in December. Subsequently, until about the 9th of January, the rain which fell was insufficient to promote uniform germination of the seed. Rainfall after the 9th of January was adequate and well distributed. Reports indicate that conditions similar to the above were experienced in most parts of the country.

On the Station, except for one field of 10 acres which had been planted a week earlier than the main crop, about 30% of the seed brairded in normal time after planting, the remainder being erratic—some as late as three weeks after sowing. The effects of this uneven germination were noticeable throughout the subsequent development of the plants. In general, those plants which got away first cropped more heavily, probably on account of their relative earliness in relation to bollworm, and, more especially, to American bollworm incidence and attack.

In such a very late season all crops had to be planted within a short period, and on this account little could be done to arrange the planting of crops so as to obtain maximum cover at flowering time against American bollworm egg-laying on cotton.

The effects of this year's jassid attack have emphasised the need of maintaining a high standard of jassid resistance in plant breeding work. The strains at present grown commercially possess a sufficient degree of resistance for most conditions, but under the exceptional attack experienced on one field this year they showed obvious signs of distress.

Final yields, owing to a combination of one or more of these adverse factors, were low. About 300 lb. of seed cotton per acre were reaped from the bulk acreages.

On farms, and from plots of cotton grown in the native reserves, yields, with few exceptions, may be considered satisfactory under the conditions of the season. In some instances yields of 500–600 lb. of seed cotton per acre have been recorded, and a few exceeded the 600 lb. mark.

BREEDING WORK.

Sub-strains of U.4/64 (G.5) easily maintained their usual superiority over all other U.4 derivatives. The two leaders U.4/64/7/10/1/No. 2 (G.5,123) and U.4/64/7/10/No. 6 (G.5,79) were, to observation, the pick of all the bulk lots grown on the Station, and observation was confirmed by the results of two strain trials. In one of these trials the U.4/64/7/10/No. 6 was yielding exactly twice as much per acre as the poorest yielder, the original U.4 bulk, and in the other some 40% more than U.4 bulk, both results being significant.

There is little to choose between U.4/64/7/10/1/No. 2 and U.4/64/7/10/No. 6; both are early, of good habit, and with good powers of recovery after bollworm attack. Their jassid resistance can be further improved—this is discussed below—but these strains have now been in commercial cultivation for two seasons and have behaved well under a range of conditions.

Other sub-strains of U.4/64, of the same general type as U.4/64/7/10/1/No. 2 and U.4/64/7/10/No. 6, have done well, but the slight superiority of the two latter justifies the greater attention given to them. The strain U.4/64/V (G.5,21) of which mention has been made in previous reports, and which has better jassid resistance than the U.4/64/7/10 type in general, has been discarded on account of its lateness; in the season under review, its slightly better jassid resistance was of no account beside its fault of lateness, which pulled its yield down well below that of the U.4/64/7/10 type. The only other U.4 family worthy of mention is U.4/34, some sub-strains of which show excellent jassid resistance, but all of which so far are late, vegetative in habit and “sticky” in their boll opening.

The promising new strains now at a stage of being bulked, are nearly all of the U.4/64/7/10 or closely related types. Rigorous culling of some 116 lots, survivors from single plant selections made in 1934, setting a high standard for jassid resistance, has left a dozen strains for bulking and further observation this coming season.

Strains such as U.4/64/7/10/1/No. 2, as mentioned above, under all ordinary conditions show sufficient jassid resistance to make them safe for Rhodesian conditions; but under exceptional epidemic jassid attack, as occurred this year on one land on the Station (discussed under jassid and plant development), they are apt to suffer to some

extent. Although such a strain is sufficiently uniform in all its qualities for commercial purposes, it still exhibits some variation ; advantage was taken of the intense jassid attack, which threw any jassid resistant strain or plant into sharp relief, to make some 380 single plant selections from this bulk and other lots, 87% of the U.4 selections being in the U.4/64 line of descent. Some very promising plants have been obtained, with apparently all the virtues of the U.4/64/7/10 type plus a very high degree of hairiness.

Concurrently with selection work, the Station has been carrying out a fairly extensive cross-breeding programme for the past two seasons, consisting chiefly of crossing the very hairy but ultra-late Cambodia variety with strains of the U.4/64/7/10 type, and back-crossing to the U.4 parent. This season 132 crossed or back-crossed bolls were obtained from 373 crosses made. It is too early to say anything of the results of this crossing, but the behaviour of a similar series of crosses, (U.4×Cambodia)×U.4, obtained from Dr. Harland in 1933, gives some grounds for expecting useful results.

Recently Introduced Strains.—The Harland crosses just mentioned are the survivors of a group of five series of U.4 back-crosses, made in St. Vincent and received here in late 1933. From the start it was seen that the only lot likely to be of much use was the AF-C series (U.4.×Cambodia)×U.4, and now, at the end of three seasons' observations on the group, the three main survivors of the 188 strains originally sent are all AF-C's. These three, AF-C 15, AF-C 26 and AF-C 38, with mass selection, have now "settled down" into discernible types, although still very variable within themselves. Their hairiness is good to excellent ; general habit approximates to that of a somewhat vigorous vegetative U.4 type ; prolificacy on the whole is not quite up to standard of U.4, but boll opening is very good. Lint quality seems to run parallel with U.4, though no detailed work has been done on this. They are appreciably later than the better U.4's, and this and their coarse habit are their main faults, but they contain distinctly promising material. Two other AF-C's of minor importance will be carried on into another season. The sole survivor of all the other series, strain AF-E20 (U.4×Gambia 14)×U.4, is worth further observation as, although it is diminutive in habit and boll size, it is prolific and early, with a fair degree of hairiness. This season, for the first time, selections have been taken from the group, the great majority being from the AF-C series.

Some strains obtained through Trinidad and planted this past season, U.4's with a red Asiatic gene incorporated, and reputedly

very early, were a complete failure owing to their lack of jassid resistance.

Four recent Barberton U.4 strains, 052, 096, 0101 and 0342 were grown here for the first time in observation plots. 096 and 0342 seemed naturally well adapted to local conditions, and grew and yielded (for the season) well. Both have a good degree of jassid resistance. 0101 was not happy in its new environment, and 052 reacted by splitting into quite a range of types, some of which are being continued as single-plant selections.

The only other new introduction tried out this season was 513, a Punjab-American strain obtained from Trought in the Sudan. The strain grew well, giving a tall, very open type of plant, but showed complete inability to recover after losing its crop during bollworm attack. The surviving bolls indicated exceptionally early maturity and as the hairiness was very good the strain may be useful in breeding work.

Plant Development.—In a twenty-acre bulk of the U.4/64/7/10 type, owing to some slight maladjustment of the double row planter, every odd pair of rows was planted at a slightly greater depth than every even pair. Moisture conditions in the soil at planting were just sufficient to allow the one set of rows to germinate at once and to grow normally, in spite of a three weeks' drought immediately after planting. The other set of rows remained dormant until after the drought of approximately three weeks, when they came away to give a perfect stand. Thus, by accident, a perfect trial on the half drill strip system, of the variables "early" and "late," was the outcome. Stand was uniform, and the difference in the start of growth between the "early" and "late" strips, a matter of three weeks, was even and clear-cut. Development records were taken over a representative (mean optimum) acre of this bulk, in which of course 50% of the rows were "early" and 50% "late." Making all allowances for adjacent row effect, which would weight heavily against the "lates," the difference in behaviour was striking throughout the season.

Growth in the "earlies" was good and in neither daily increment nor in absolute height at the end of the season was it ever equalled by the "lates." Flowering (records being taken on 4% of the acre in each case) started with two weeks' difference between the two variables, and at its peak that of the "lates" was less than half that of the "earlies."

Mid-season growing conditions were excellent and, until the end of the effective period of flowering at the onset of colder weather, natural

shedding was negligible. Damage by American bollworm increased steadily, and as the attack followed the same calendar date throughout the field, the initial poorer position of the "lates" was greatly aggravated—bollworm damage was accounting for a loss of about 20% of the flowers formed in the "earlies" for the first 20 days of flowering, the loss rising to about 80% of the flowers formed in the next 30 days, whereas in the "lates" the loss of flowers had reached 50% by the 10th day from the start of flowering, and 80% by the 30th day. Thus not only was the proportion of surviving flowers greater in the early variable, but the absolute numbers, coming from a much greater flowering curve, were many times more. This was reflected in the yields, 480 lb. seed-cotton per acre for the "earlies" and 133 lb. per acre for the "lates," a (virtual) difference of almost three weeks in the planting date thus accounting for a difference in crop of nearly 350 lb. per acre.

Development records were also taken in a bulk of the U.4/64/7/10 type in the land which (as discussed under "Insect Pests") suffered an epidemic of jassid attack. Growth and flowering were excellent, but in spite of the fact that this cotton was the earliest planted on the Station, brairding a full fortnight ahead of the "early" cotton mentioned in the last paragraph, the yield from the recorded area was little over 300 lb. of seed-cotton to the acre. American bollworm attack on this land was relatively light, and bollworm shedding loss during the effective period of flowering rarely reached 50% of the flowers formed. By the end of March, however, when the natural shedding in the other cotton lands was still negligible, the natural shedding here had risen to 40% of the flowers (*i.e.*, flowers or their resulting young bolls) formed. The same story was revealed by the budding and bud-shedding records. The land was in reasonably good heart, and the heavy shedding must have been due largely to the jassid attack. Samples of the lint from this land were examined by Mr. Hesse, the cotton grader, who reports that, compared with the lint from the other lands where the jassid attack was of only "ordinary" severity, the samples from the jassid-struck land were softer, much neppier, and altogether poorer in character.

Two Latin Square spacing trials, each of six variables, gave results conforming with previous experience, namely that on the soils of medium fertility typical of the Station, spacings in the row of one plant at 6 inches or two plants at 12 inches, gave heavier yields of seed-cotton per acre than any wider spacings such as one plant at 12 inches, one at 24 inches, or two at 24 inches. Included in these two trials was one variable thinned later by three weeks in one trial, and by

four weeks in the other, than its fellow variables. The depressing effect on yield of late thinning, caused by throwing the subsequent development of the plant later, was seen in the yields, these being in the one trial 50% below those of the same spacing thinned at the orthodox time, and 25% below in the other trial.

Fertilisers and Manures.—Observation strips of different fertilisers in cotton bulks—sulphate of ammonia at 200 lb. per acre; blood meal at the same rate, and lime at 1,000 lb. per acre—showed no demonstrable effect due to the fertiliser, apart from possibly slightly delaying maturity in the case of the blood meal.

Approximately 200 tons of compost, made on lines similar to the Indore process, was manufactured during the rains. About 30 acres of land, which are to be planted to cotton in 1936–37, have been composted at the rate of 5–6 tons per acre. Other similar acreages have received heavier applications of 10 and 20 tons per acre.

INSECT WORK.

American Bollworm.—Records of egg-laying were taken on cotton as well as on other crops such as maize, milo maize, amber cane, kaffir corn, wintersome, sunflowers and dolichos beans. The course of larval development was recorded only on cotton. Plant development was not uniform owing to inadequate rains at planting. In this field of cotton, about 50% of the seed did not braird until some two weeks after the first lot. However, in the following discussion on the intensity and incidence of egg-laying on different crops, the data for eggs laid on cotton are taken from the earlier plants. As irregular brairding also took place with many of the other crops, records are comparable.

Egg-laying was heavier than last season and lighter than in 1933–34. It lasted on cotton for nearly four months, starting about the end of the first week in February and finishing about the last week in May. But the main egg-laying on cotton took place within about a month, from March 12th to April 10th, and during this time a peak period of about two weeks occurred, from March 23rd to April 6th. The course of this oviposition follows closely the rate of flowering of the cotton plants. With the very late planted crop of this season, flowering started about February 20th and was at its maximum during the last week of March and the first week of April.

Analysis, on a per hundred plants per day basis, of eggs laid on many crops in the vicinity of the cotton crop under discussion, shows that from the start of egg-laying, about the 7th February, until mid-March—a period of five weeks—oviposition occurred on the cotton,

three maize crops and milo maize. Within this period during which, incidentally, flowering on cotton had not yet risen to its peak, the number of eggs laid was slightly more on maize and much greater on milo maize than on cotton. The last of these grain crops became increasingly unattractive to egg laying about mid-March. About this time egg-laying on cotton increased with an increase in flowering; it was at its peak during the last week of March and the first week of April. During the period, when egg-laying was at its heaviest on the recorded cotton (44 acres), other crops on which eggs were laid were kaffir corn (6 acres), amber cane (4 acres), maize planted late for ensilage (15 acres), a late variety of millet (2 acres), and on dolichos beans (4 acres). The kaffir corn and amber cane proved to be about as attractive as cotton to the egg-laying moths. Dolichos beans and the millet were laid upon to a greater extent than cotton. With dolichos beans, not only was the number of eggs laid larger but, in addition, this crop remained thoroughly attractive for a period of about five weeks at a time when the cotton was most attractive to egg-laying moths.

Although eggs were freely laid on the relatively small acreages of other crops at the time of the peak egg-laying on cotton, yet it cannot be said that oviposition on cotton was greatly depressed; it is suggested, however, that it was partially alleviated.

As dolichos beans have this season proved to be attractive to egg-laying moths for a long period, and at a time when such attraction would be of benefit to the cotton crop, it is intended to test this crop further for its possible value in alleviating the egg-laying on the cotton crop. Other varieties of peas and beans will, similarly, be tried. If a suitable bean crop which would take an adequate share of eggs laid could be found, it is thought, for several reasons, that it would be more easily incorporated into farming schemes than many of the millet crops, which have recently been tested in these investigations. Doubtless those millets which are also food crops will serve a useful purpose in alleviating egg-laying on cotton, in areas where the crop is grown by natives.

This season, compared with those of 1933-34 and 1934-35, the numbers of larvæ which survived to the sixth instar were much larger. The observation has been made that the proportion of bolls which are older than three weeks from the dates of their flowers, and which are attacked by bollworms, is small. This season, however, damage to large, well-formed bolls was noticeably heavy in the fields. At the start of flowering about 20% of the dated flowers were subsequently shed as bolls, with bollworm punctures. Later, during the main flowering

period, the percentage increased to over 60%, rising to a peak of about 80%. Also, 15% of the loss of matured bolls showed visible bollworm punctures and contained worthless seed cotton. In a further 2% of punctured locs the seed cotton was heavily discoloured. It is well nigh impossible to estimate what proportion of such damage was caused by American and Sudan bollworms respectively. But the large sixth instar larval population of American bollworm, taken in conjunction with the nomadic feeding habits of the pest, are facts which might with reason be taken to convict American bollworm of the greater share of the damage to the crop.

Sudan Bollworm.—Over 2,000 fifth instar larvæ were put in field cages to pupate during April 1935, but the numbers of moths obtained in October, November and December from the pupæ were too meagre to give any accurate indication of moth emergence from overwintering pupæ. On examining the earth of the cages numerous soil cells with disintegrated pupal cases were recovered. In the 1934–35 season, however, the hatchings of moths in these cages followed closely the oviposition on plants growing on a small area of standover cotton. The cages are again in use, about 6,000 larvæ having been placed in them during April and May 1936.

An examination of the records of egg-laying, which took place on standover cotton plants on the Station over the past three seasons, indicates that eggs may be laid from mid-October to January, February or March—probably longer—the plants being uprooted sometime during the latter months. The peaks and troughs of such egg curves do not coincide for the different seasons, no doubt owing to the influence of climatic and other factors on the overwintering pupae.

Similarly, depending on the type of season, egg-laying on the young plants of the past three annual crops has started about the last week of January, or early in February. Where only annual cotton is grown, this egg-laying, which is dependent for its quantity on moths hatching from the last of the overwintering pupae (1934 data), remains at a low level for about seven weeks. After such a period of time the insect completes its full life cycle and an increase of egg-laying becomes apparent. But if the small moth population which emerges from overwintering pupae from the end of January to early March is supplemented in numbers with moths bred up during October to December, on standover or ratooned cotton, a much heavier egg-laying might be expected on the annual crop, from the end of January to March, *et seq.* As February and March are, in the majority of seasons, the months of the important flowering and setting of the crop, it is

imperative to practise measures to reduce to a minimum the insect pest populations which damage the crop at this time. To this end both European farmers and native growers have been warned of the dangers of ratooning cotton. Legislation on such matters is being sought.

Cotton Stainers.—This year stainers were first recorded about mid-March. Of the three species which were present in the crop at this time, *D. fasciatus* occurred in greater numbers than *D. intermedius* and *D. superstitiosus*. The last named was found in very small numbers throughout the season. During the course of the season the population of *D. fasciatus* tended to increase and it showed marked increase about mid-June. The population of *D. intermedius* was numerically erratic : there were many fluctuations but no definite trend leading up to a large increase of population as occurred with *D. fasciatus*.

As Pearson's work at Barberton indicates that the development of internal boll disease in the boll appears to spread more rapidly in bolls 4-8 weeks old than in bolls 0-4 and 8-10 weeks old, it will be convenient to use these time intervals, starting from the period of maximum boll-setting, as a basis on which to consider stainer populations. The crop, this season, was made from flowers produced during the third week of February to about mid-April, the bulk of it being obtained from that flowering which took place in the second and third weeks of March, with a peak period about mid-March. Bolls set during this peak period took about 80 days to mature. An examination of the records of the total adult stainer population show that these, in general, remained below 500 per acre during the first four weeks of the development of the majority of bolls. The population then rose to 1,000 and, subsequently, to about 2,500 per acre over the next four weeks, ending mid-May. They remained at this level until after the peak of boll opening had occurred about mid-June. Thereafter the population, which consisted almost entirely of *D. fasciatus*, became markedly more numerous ; and it decreased in the last weeks of July and in August. Records were discontinued late in August.

Some idea of the percentage of the degree of staining, which was caused by these populations, may be gained from the records of the staining of green bolls. The percentage of those bolls which were moderately or heavily stained only amounted to about 5% during April and the first two weeks of May ; it then rose to 20% in mid-June. By this latter date, however, the bulk of the crop was already matured. Finally, it may be stated that the loculi of matured bolls, which were

not damaged visibly by bollworm punctures, and in which the seed cotton showed light, very light, or no staining, amounted to between 80 and 90% of the total crop.

Jassid.—Although jassid attack on two out of the three fields of cotton on the Station was light—as with the country in general this season—or moderate, the third field suffered from a protracted epidemic attack.

This field, isolated from the next nearest (annual) cotton by over a quarter of a mile, was planted a fortnight earlier than the other fields, and was sufficiently advanced to be attractive to jassid when the other cotton was barely past the seed-leaf stage. Once the jassid had gained a foothold here, by the third week in January, it remained epidemic, for almost the whole period until the beginning of May. Several factors probably predisposed this field to the original infestation: a nearby block of experimental ratooned cotton doubtless acted as a breeding ground for jassid, and when this was partially chopped out in mid-January an influx to the annual cotton occurred; the field in question contained several shrub-grown out-crops, probably also a source of infestation; and weather conditions were favourable to jassid.

The attack was the heaviest in intensity and duration ever experienced on the Station, so far as comparable records show. A small plot of the jassid-susceptible Bancroft was already stunted and checked in growth by the end of the first week in February. Jassid counts at this time were recording over 6 nymphs per leaf on Bancroft: the attack lessened slightly during February, but although it rose again by the beginning of March, by this time Bancroft was useless as the criterion of jassid attack, as all the foliage was completely shrivelled. This Bancroft plot, in spite of a fair stand, eventually yielded at the rate of 4 lb. of seed cotton per acre.

The U.4 lots made a good showing against this attack. By the end of March, however, the incidence on U.4 lots had reached the unprecedented figure of 8 nymphs per leaf (compared with the previous heaviest infestation recorded on U.4 strains of around 3 nymphs per leaf in 1932 and 1930) and the sub-strains were beginning to suffer in varying degree. Leaves were becoming reddened, and brittle at the edges, and the interference with photosynthesis doubtless, accounted for the fairly heavy natural shedding taking place in this field.

The attack faded in April, and only the onset of cold weather prevented the U.4 lots, which were still full of vigour and reacting remarkably quickly to the improved position, from setting a good

top crop. As it was, the bulks in this field gave a crop of about 300 lb. seed cotton per acre, a tribute to the toughness and powers of recovery of U.4 under abnormally heavy jassid infestation. The attack was of great use in the plant breeding work, allowing a thorough estimate to be made of the relative and absolute jassid resistance of the various sub-strains.

Aphis.—Aphis damage was negligible compared with the previous season. There was a sharp, but short, attack late in the season. Jassid and aphis, so far as Station records show, have never both been epidemic in the same season.

INVESTIGATIONS AT THE SABI TANGANDA ESTATE.

On account of the damage done to cotton by stainers and the Sudan bollworm, it is not possible to grow a remunerative crop, during the rainy season, in this area of low altitude. Attempts are being made to grow an out-of-season crop under irrigation.

Records taken on plant development and insect attack during 1935 indicated that, if cotton were planted sometime in late February, or early March, it might escape serious damage from stainer attack. On this evidence about 25 acres were planted during the last few days in February and the first week of March this year. Records which have been taken on this crop, from May to October, have given figures very similar to those taken over the same period in 1935. Briefly, the stainer populations remained below 500 adults per acre, during the development of the crop, until mid-September. They then showed signs of increasing. The principal species has been *D. fasciatus*. *D. intermedius* occurred in relatively small numbers, and an occasional *D. nigrofasciatus* was taken in the crop. The first of the green bolls (about three weeks old) examined were about 25% heavily stained. Later, as bolls became more numerous, the percentage decreased to 10–15% and subsequently below 10%. Similarly, at the start of boll opening, the percentage of heavy staining of matured bolls was about 40%, but this fell rapidly to 10–15%, at the time when the greater portion of the crop was maturing during September.

Over the period May to September, stainers have not been found on any other than the following alternate host plants. Baobab was the most important, stainers (chiefly *D. fasciatus*) being found on the trees from May to September. The insects were recorded from *Thespesia* during June, July and August; and on *Sterculia rogersii* in August.

Damage caused by bollworms was negligible.

Despite the above results, which indicate that insect pests have not been serious factors in reducing yields, recent reports tell that the actual crop picked is meagre. And although there is a good top crop of healthy green bolls it is doubtful, because of the recent (October) increase in stainer population, whether seed-cotton free of much staining will be reaped from these bolls. In dealing with some of the previous crops, loss due to stainer damage has possibly been masking losses caused by other factors; and these latter are now assuming major importance. Thus with this year's crop, growth was rank and of a lush type, and shedding of the young bolls was high. It is hoped that such loss will be lessened as further experience is accumulated on matters such as the water, and the spacing requirements, of the crop.

COTTON STATION, GATOOMA.
DAILY RAINFALL, SEASON 1935-36.

Date.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
1 ...	—	—	—	—	—	0.05	0.21	—	—	—	0.02	—
2 ...	—	—	—	—	—	—	0.07	—	—	—	—	—
3 ...	—	—	—	—	0.05	—	0.30	—	—	—	—	—
4 ...	—	—	—	—	0.07	0.04	0.72	—	0.04	—	0.02	—
5 ...	—	—	—	0.02	0.02	0.13	1.11	—	—	—	—	—
6 ...	—	—	—	0.04	—	0.28	0.49	—	—	—	—	—
7 ...	—	—	—	—	—	0.13	0.13	—	—	—	—	—
8 ...	—	—	—	—	0.21	1.02	0.79	—	—	—	—	—
9 ...	—	—	—	—	0.57	0.02	—	—	—	—	—	—
10 ...	—	—	—	—	0.15	0.26	0.01	—	—	—	—	—
11 ...	—	—	—	0.01	0.89	0.11	0.16	—	—	—	—	—
12 ...	—	—	—	0.39	—	—	1.54	—	—	—	—	—
13 ...	—	—	—	0.30	—	—	0.05	—	—	—	—	—
14 ...	—	—	—	—	0.16	1.64	0.03	—	—	—	—	—
15 ...	—	—	—	—	0.43	2.22	—	0.94	—	—	—	—
16 ...	—	—	—	—	0.29	—	—	0.64	—	—	—	—
17 ...	—	—	—	2.31	0.30	—	0.06	—	—	—	—	—
18 ...	—	—	—	0.45	0.20	—	0.03	—	—	—	—	—
19 ...	—	—	0.22	—	0.85	—	—	—	0.02	—	—	—
20 ...	—	—	—	2.29	—	0.10	—	—	—	—	—	—
21 ...	—	—	—	0.02	—	—	—	—	—	—	—	—
22 ...	—	—	0.38	—	—	—	—	0.08	—	—	—	—
23 ...	—	—	0.01	—	—	—	—	—	—	—	—	—
24 ...	—	—	0.14	—	—	—	—	—	—	—	—	—
25 ...	—	—	—	—	—	—	0.01	—	—	—	—	—
26 ...	0.30	—	—	—	—	0.22	—	0.03	—	—	—	—
27 ...	—	—	—	—	—	1.43	—	—	—	—	—	—
28 ...	—	0.03	—	—	—	0.02	—	—	—	—	—	—
29 ...	—	0.01	—	—	—	0.07	0.42	—	—	—	—	—
30 ...	—	—	—	0.06	0.02	—	0.65	—	—	—	—	—
31 ...	—	0.08	—	—	1.58	—	0.06	—	—	—	—	0.10
Total ...	0.30	0.12	0.75	5.89	5.79	7.74	6.84	1.69	0.06	—	0.04	0.10

Total rainfall for the year, 29.32 inches.

NORTHERN RHODESIA.

RESEARCH STATION, MAZABUKA.

PROGRESS REPORT ON THE COTTON WORK, SEASON 1935-36.

BY

A. G. BEBBINGTON (*Empire Cotton Growing Corporation*) AND W. ALLAN
(*Northern Rhodesia Department of Agriculture*).

SEASON.

The rains were later than in any season during the past eight years, and no planting was possible until the 20th December. The plants were further handicapped by a drought of 14 days which set in immediately after germination. There were, however, good late rains in March which prolonged the growing season and compensated to some extent for the earlier set back. Jassid occurred in considerable numbers and some of the bulks showed quite considerable damage. The American bollworm did not cause any serious loss of crop and in addition, the attack of *Dysdercus supersticiosus* was light while that of *D. fasciatus* did not develop until late in May. As a result, yields on the station were unusually good, varying from 260 to 500 lbs. of seed cotton per acre.

COTTON EXPERIMENTS.

The information obtained at Mazabuka over the past eight years has definitely shown that country of this type is unsuitable for cotton-growing, owing to the frequent occurrence of crop failures. The series of trials of different vegetational areas by means of small scattered plots of native-grown cotton have now defined for us certain types of country in which we know that cotton can become a cash crop for the native. As a consequence the work at Mazabuka has been reduced to the maintenance of a seed supply and the detailed work on American bollworm and the stainers, particularly *D. supersticiosus*. The remainder of the season's work was carried out in six native areas.

Observation and Bulk Plots.—A series of observation and bulk plots of 27 strains derived from U.4 from Barberton and Gatooma were

grown, and of these 6 were discarded. Further trial of the series of crosses (U.4 × Cambodia) × U.4 led to the discarding of all but 11 of these, from which single plants and special bulks were taken. These types may be of value on some of the lighter soils in native areas where frost does not occur and where the attack of *D. fasciatus* is light.

The Agricultural Department has recently opened a station in one of the native areas suitable for cotton. A start will be made in the coming season to provide a strain of U.4 possibly more suited to the district.

INSECT WORK.

Bollworm.—The attack of American bollworm (*Heliothis obsoleta*) was rather heavier than in the previous season but did not occasion serious damage to the crop. Egg counts were carried out on five plantings of maize, sorghum, groundnuts and native beans, in order to test their efficacy as trap crops. The counts on maize and cotton were duplicated on a nearby farm. The counts on the various crops showed that maize was by far the most attractive to the moth. Laying increased steadily to a peak as the maize came into tassel, while that on the other crops was variable showing no definite maximum point. The numbers of eggs laid on maize were, at tasselling, always greater than those on cotton, varying from 4 to 20 times the number, while those on the other crops rarely exceeded the number on cotton. Very considerable damage was done to the beans by the Cantharid beetle (*Mylabris dicincta*) and this probably renders the records of little value.

Stainers at Mazabuka.—The recording of stainers on cotton and on the wild hosts at Mazabuka was continued. These records showed a very considerable variation in the attack of both *D. superstitiosus* and *D. fasciatus* from that of previous seasons.

Dysdercus superstitiosus.—The late rains caused an unexpected variation in the host sequence of *D. superstitiosus*. In previous seasons the first migrant population has been attracted to *Hibiscus trionum* in late December when the plants came into flower. In the present season, however, the flowering of this host was delayed by 17 days and, apparently in consequence of this, the great bulk of the influx population congregated on the deep rooted perennial *H. baumii*, the flowering of which was not affected by the lateness of the rains. Only a negligible fraction of the population appeared on *H. trionum*, a complete reversal of the usual distribution between the two hosts. This had a very important effect on the attack of *D. superstitiosus*

on cotton, because the development period of nymphs fed on *H. baumii* is nearly three times as long as that of nymphs fed on *H. trionum*. Consequently the F₁ generation did not mature until the *H. asper*, *H. cannabinus* complex was about to flower; there was in effect but a short break in the host sequence, and the population on cotton never reached a high figure. The sequence of events in the field was successfully reproduced in the insectory and further information was obtained on the problem of survival. It was found that a very small percentage of the insectory population survived from June to September and that no breeding took place. In October, after the rise in temperature, the survivors produced a large number of nymphs which developed with great rapidity on suitable food. It was also found, as a result of detailed laboratory investigation, that the period of nymphal development varies greatly on different host plants.

Dysdercus fasciatus.—Records on this species and its host, *Thespesia rogersii*, were continued. These showed that the flowering rate of *T. rogersii* was very much higher than in previous seasons. Also a very much larger proportion of the early crop survived due to the negligible attack of the *Cossid* moth larva. As a result, the normal food shortage to which the species is subjected did not occur and the stainer consequently did not appear in cotton until late May. A similar distribution was recorded by us in 1933.

Stainer in Native Areas.—In addition to the stainer records at Mazabuka, similar recording was carried out on cotton and on wild hosts in six native areas. In the three districts mentioned in last year's report, a similar sequence of both species was observed on the wild hosts while the attack on cotton was also similar. In one of the new districts, *i.e.*, Southern Plateau, the same general distribution was recorded. In the two districts typical of the Barotse sands, new annual hosts of *D. superstitiosus* were found, while the host and distribution of *D. fasciatus* proved to be the same as elsewhere. The records of distribution on cotton in these two cases cannot be said to give a very true picture as the growth of the cotton was too poor.

A further link in the sequence of *D. superstitiosus* covering the latter part of September, October and early November has now been found. In both the Northern and Southern Plateaux the species has been found living and breeding quite freely on a species of *Triumfetta* in favourable situations. We have now recorded *D. superstitiosus* in the field throughout the year and the general picture of the food sequences appears to be fairly complete.

NATIVE AREAS.

The trials of small plots of cotton were extended in the areas where previous experiments had been carried out, and three further areas were included. In particular, two districts typical of a large part of the Barotse Province were included.

In all cases the rains were late with consequent delay in planting, while in districts I-IV severe frosts were experienced in May which very considerably reduced the yields.

District I.—(Transitional Kalahari Sands). Late planting was followed by a very serious attack of the giant cricket (*Brachytrypes membranaceus*) which completely destroyed the majority of the plots, and as it was too late to replant, the trials were more or less a failure. The only surviving plot, which was very late planted, yielded at the rate of 152 lbs. of seed cotton per acre. It is thought that cricket damage may be avoided by early planting as on those plots attacked the smallest plants suffered most.

District II.—(Transitional Soils). This area is transitional between the fertile *Acacia* savannah and the *Brachystegia* soils of the Southern Plateau. Yields were fair, but depressed by late planting and the fact that the majority of growers put their crop on old and very weedy lands. The highest yield was 260 lbs. and the average 179 lbs. of seed cotton per acre.

District III.—(*Brachystegia* soils of the Southern Plateau). In spite of late planting and early frosts the yields were good, the highest being 506 lbs. and the average 257 lbs. seed cotton per acre.

District IV.—(*Isobertinia-Brachystegia* soils of the Northern Plateau). The same remarks apply to this district as to the last, although yields were rather lower, the highest being 234 lbs. and the mean 176 lbs. of seed cotton per acre.

District V.—(Kalahari Sands). The soils vary from a loose Kalahari sand to the rather more dense transitional type as in District I. The loose sands are quite unsuitable for cotton, the yield being no more than 30 lbs. of seed cotton per acre. The firmer sands gave better results, the highest yield being 164 lbs. and the mean 135 lbs. of seed cotton per acre.

District VI.—(Loose Kalahari Sands). It was found that the looser types of Kalahari sand soils typical of central Barotseland are totally unsuitable for cotton-growing.

To summarise these results it may be said that the transitional and plateaux soils appear to be suitable for cotton. While the yields seem somewhat low, they are sufficient at present prices to give the native at least as good a return as he can obtain from maize, while the

better yields have been obtained in areas where but little maize is produced for sale. In addition, cotton provides a badly needed rotation crop for the chief maize-producing districts where large areas of land are cropped continuously with maize.

The plots were grown by natives unfamiliar with the crop and reluctant to follow the advice they were given. In many cases the cotton was put on unsuitable land, and cultivation was generally sketchy, but it may be expected that as the native becomes familiar with the crop, yields will improve.

ANGLO-EGYPTIAN SUDAN.

PROGRESS REPORT ON THE WORK ON COTTON CARRIED OUT BY THE PLANT BREEDING SECTION, AGRICULTURAL RESEARCH SERVICE, SEASON 1935-36.

BY

TREVOR TROUGHT.

ORGANIZATION AND STAFF.

This season effect has been given to the changes in the organization of the Section to which reference was made in last season's Progress Report. These changes are the outcome of the larger reorganization by which all research work directed to agricultural problems has been consolidated into one service—the Agricultural Research Service—and made a direct accessory of the Department of Agriculture and Forests.

Although all the changes were not entirely completed within the compass of one season, it is convenient to note here the situation as it is at the time of writing, when at least a temporary stability has been attained.

The Plant Breeding Section Headquarters is now on the Gezira Research Farm. A new experimental ginnery and storehouses have been built by the Government, and laboratory and office accommodation provided in an existing building.

The breeding of Egyptian types of cotton will be done here, and it is intended to add sorghum and leguminous crops to the sphere of activity.

The Shambat Sub-Section remains at Shambat. Propagation to bulk of promising strains of both American and Egyptian types is carried on there, and the preliminary work of breeding blackarm-resistant types is also temporarily located there.

Kadugli Sub-Section, at Kadugli in the Nuba Mountains, has been founded to undertake the breeding of American cottons under raingrown conditions. The Government have provided laboratory and housing accommodation and Mr. R. R. Anson joined the Section in September 1935 and opened the station at the beginning of the 1936/37 season.

It may be said that, in spite of these administrative changes, the technical work of the section has been carried on with surprisingly

little dislocation, though this has, at times, only been accomplished by considerable extra work by the staff.

GENERAL.

The yield in the Gezira was satisfactory, being slightly over average. X1530, sown over an area of 57,240 feddans in the Southern Gezira, gave an average yield of 4.73 kantars per feddan.

In Hag Abdullah block, on 5,813 feddans, this type gave the very high average yield of 6.23 kantars per feddan.

With so large an area now under cultivation (for, in addition to the area mentioned above in the Gezira, 13,534 feddans were sown in the Gash Delta and the whole of the Tokar Delta was under X1530, or X1530A) this type passes into the category of a "commercial crop", and the Plant Breeding Section's activities become directed to its supersession by a superior type.

Climate.—In the Gezira the distribution of the rains was not entirely normal. April and May had more rain than usual while June and July were rather short of rain. In August the rainfall was average and below average in September. The total of the year (325 mms.) was below average (400 mms.). May was cooler than usual, and December (1935) and January (1936) were quite cool, with low night humidities.

At Shambat the rainfall (154.5 mms.) was slightly above average (143 mms.) and the winter months were cool, and drier than usual.

Diseases and Pests.—The Gezira was not affected seriously by either Blackarm, leaf curl, or Pink bollworm—the three major troubles to the crop.

At Shambat Pink bollworm was once again severe, though not so bad as last year; Blackarm was negligible, and leaf curl unimportant.

"Nimitti" (*Simulium spp.*), small biting flies which attack human beings and animals during the day) were troublesome to all the staff working in the field.

EXPERIMENTAL RESULTS.

Egyptian Cottons—Breeding Work.—Satisfactory growth and good yields were obtained.

Selection was directed mainly to the improvement of lint quality in the X1530 and X1730 types and to improved yield and lint uniformity in XO4729 and related types.

Spectacular progress cannot be expected in this work, but results of spinning and grading tests on earlier selections show that progress is being maintained.

The selection of more leaf curl resistant types from the NT2 strain showed marked progress.

Hybrids of Ishan, Tanguis and Afifi with Sakel or Sea Island were carried on and some families were bulked for yield testing.

The important work on blackarm resistance was continued.

The programme of crossing and backcrossing was carried out successfully and, in order to take advantage of the superior lint qualities of NT2, (ex. Gash Sakel), work was extended to include this strain in the crossing programme.

American Cottons—Breeding Work.—Work continued on the isolation of substrains of types 511, 513 and 514, to obtain improvements in particular respects in these types. For example, type 511 is heavy yielding and with good lint, but has a somewhat lax habit of growth, 513 is early and heavy yielding, but would be better with a longer lint, etc.

New selections were tested, and a considerable number of promising families, derived from "Harland's Hybrids" were grown.

Hybridization work to produce blackarm-resistant types was continued; the progenies from other crosses between types mentioned above were grown and further selections made.

Propagation of Egyptian and American Strains.—The usual propagation of new types to provide sufficient seed for large-scale testing was carried out at Shambat.

There were also roguing plots of X1730A and other types which previous testing had shown to be likely candidates for more extended cultivation.

The "513" strain was grown on the Gandeto Government pump scheme in Berber district, and gave a 55% greater average yield than Webber.

XA129—a selection from Pump Scheme Strain which has proved suitable for parts of the Equatorial Province—was propagated in the South under the auspices of the Department of Agriculture & Forests and a considerable extension in the area under this variety is being made in the 1936/37 season.

VARIETAL TESTS.

(a) *Egyptian Varieties.*—A "Line Test" was grown at the Gezira Research Farm on the standard layout. Only NT3* and X1530E gave appreciable increases over the control type X1530A. But some other types, with better lint quality (e.g. NT13, a selection from

* NT3 is a Leaf Curl-resistant Sakel with rather rougher lint.

XO4729, and NT22 derived from a Sakel $\times$ Afifi cross) gave yields approaching the control.

Varietal Tests were grown on the seed farm at Barakat and near the Gezira Research Farm (on the Suriba canal, in the Barakat Block).

This latter site was put at our disposal through the courtesy of the Sudan Plantations Syndicate, in order to avoid the possibility of serious white ant attack, pending proof by the Entomological Section that white ants could be satisfactorily controlled on the Research Farm.

At both sites X1730A gave a significant increase over X1530A (the control) in lint yield, while Sakel gave the worst yield at both places.

NT3 did not show a significant difference from X1530A, though slightly higher in yield.

The Preliminary Varietal Test was also on the Suriba Canal. X1730D was slightly better than X1530A and NT2 was somewhat worse, but the differences were not significant.

Comparative Inspection Plots.—Four plots, scattered over the Gezira area, were grown, comprising the types NT2, NT3 and X1730A. The results from individual comparisons varied greatly, though the averages of all four places showed good general agreement with the Varietal and Preliminary Varietal Test results.

In the Gash Delta, an experiment was made to test whether simple comparative trials of this nature would be of value. A knowledge of the difficulties encountered will be of use if further trials are made.

(b) *American Varieties.*—A Line Test was carried out at Shambat, and showed that progress was still being made in the production of improved types. One of the selections from "Harland's Hybrids"—originally U.4 $\times$ Jamaica Xerophytic—gave a good yield and long lint.

Varietal Tests were carried out at five sites, two in the Nuba Mountains (Kadugli and Talodi) and three in the Equatorial Province (Maridi, Kirripi and Opari).

The reliability of the Nuba Mountains plots was unfortunately affected by a shortage of rain which necessitated considerable re-sowing.

In the Equatorial Province, the general regularity of the plots was satisfactory. XA129, which was used as the control type, gave the highest yield of lint at each place. But selections of longer stapled types were very near in actual lint yield, and the longer stapled types such as 511A, when a market has been established for them, should show a greater profit per feddan.

Comparative Inspection Plots were grown on the Gandeto Pump

Scheme, with "Webber" as control. "513" repeated its previous convincing performance in Varietal Trials, giving 6.22 large kantars per feddan or over $2\frac{1}{2}$ kantars per feddan greater yield than the control.

GRADING AND SPINNING TESTS.

Acknowledgments are due to Messrs. Wolstenholme and Holland and the British Cotton Industry Research Association for their courtesy in carrying out these tests.

The results were on the whole as expected, though there were some discrepancies between the graders' valuations and the spinning tests. In the Egyptian series NT2 was again outstanding, and Lecrem spun very well; Gezira Main Crop at Barakat spun better than was expected from the graders' report, and was superior to X1530A at Barakat and about equal to X1530A on the Suriba canal. X1530A samples grown in different places within a few miles of one another varied in quality and were valued from 40 points on to 100 points on. These fluctuations can probably be ascribed to the effects of differences in sowing and picking dates.

In the American series, XA1129 again gave the best spinning result, and XA129, in Equatorial Province, though shorter in staple, again gave stronger yarns and better spinning results than other types under comparison.

[Included by courtesy of the Uganda Government.]

UGANDA

COTTON EXPERIMENT STATIONS, BUKALASA AND SERERE. PROGRESS REPORTS FOR THE SEASON 1935-36

BUKALASA ZONE.

BY

G. W. NYE

METEOROLOGY.

The weather during the planting season was abnormally dry and the value of early planting was clearly demonstrated. December and February were wet months which retarded maturity and caused much stained cotton. The wet periods caused a flush of late budding which resulted in a prolonged picking season.

WEATHER CONDITIONS.

<i>Month.</i>	<i>Rain.</i>	<i>Sunshine.</i>	<i>Temperatures.</i>	<i>Remarks.</i>
April ...	1·8 inch below average.	Above average.	Average.	
May ...	5·8 inches above average.	Average.	Below average.	Cold.
June ...	1 inch above average.	Average.	Below average.	Good for cotton planting.
July ...	3 inches below average.	Much above average.	Above average.	Cotton planting almost impossible.
August ...	2·9 inches below average.	Above average.	Above average.	Few days only fit for cotton planting.
September ...	2 inches below average.	Above average.	Above average.	
October ...	·7 inch below average.	Average.	Average.	The first normal month of the season.
November ...	1·6 inches below average.	Above average.	Above average.	Good month for cotton.
December ...	3·1 inches above average.	Average.	Below average.	Cool. Rain concentrated in latter half of month.
January ...	·6 inch below average.	Below average.	Below average.	Many overcast days.
February ...	4·56 inches above average.	Below average.	Below average.	Much rain damage to cotton.

BREEDING WORK.

The Breeding Plot consisted of the usual collection of New Selections and Pedigree Lines with the addition of a series of F_1 's from crosses made in the previous year. Despite adverse weather conditions quite satisfactory yields were obtained. Selection for resistance to Blackarm was not easy on account of the comparatively slight incidence of the disease. In the case of wilt, however, rigid selection was possible and any plants showing signs of attack were discarded. Some evidence

of resistance was present, but it is too early for any optimism on this question. It is however, clear that derivatives of B.37 are very susceptible to wilt.

The most promising of the New Selections were U.B. 24/4 (a selection from U.4.130 originally obtained from Rhodesia), B.180 group, B.181 group, and B.147. U.B.24/4 yielded quite well and produced the best quality of lint that has yet been obtained from a U.4 derivative in this country. It appears to be rather susceptible to Blackarm. It is curious that in general U.4 derivatives are more susceptible to Blackarm at Bukalasa than at Serere.

The B.180 group maintained its uniformity and was remarkably free from Blackarm. It is, however, late maturing and selection away from this character is being attempted. The B.181 group yielded well and were also resistant to Blackarm. B.147 may be a U.4 derivative; it yielded very well indeed but the lint was short and harsh.

The Pedigree Lines provided plenty of interesting material. The B.P.52 group again exhibited tolerance of heavy Blackarm infection. Several strains of this group are very promising as they yield well and have long lint. S.G.23/8 derivatives were generally short stapled, but it is interesting to note that considerable improvement in resistance to Blackarm has been obtained by selection within this strain. Families of the B.P.50 group (B.37 origin), while extremely promising as regards lint characters and habit of growth, were on the whole highly susceptible to wilt.

INCREASE PLOTS.

B.P.50 had been put into the 18-acre bulk increase stage, but such a high percentage of plants was attacked by wilt that it has been necessary to discard this strain. A $1\frac{1}{3}$ -acre plot of B.P.79, a son of B.P.50, gave good promise, especially as its ginning outturn was 3% higher than that of the local strain. The $\frac{1}{4}$ -acre plot of B.P.89, a son of B.P. 52, was disappointing. Another $\frac{1}{4}$ -acre of B.P.104, a derivative of S.G.23/8, did well and its lint was placed high in the list of samples examined by a local grader.

VARIETY TRIALS.

A *Miniature variety trial* was grown for the first time to give a preliminary yield trial to the most promising of the Pedigree Lines. Several lines yielded better than Local.

In the *Main Variety Trial* it was noteworthy that the early maturing varieties gave very much greater yields than Local. B.P.52 gave 1,389 lbs. seed cotton per acre, B.P.75 (a B.P.50 derivative) 1,271 lbs.,

while Local gave only 843 and S.G.23/8 758 lbs. The season definitely favoured early maturing varieties; the picking peak of B.P.52 was February 12th and that of Local was on March 4th. An analysis of variance was done for ginning outturn and all varieties except B.P.75 were better than Local in this respect. With regard to Blackarm, counts showed that B.P.52 had significantly more Blackarm lesions per plant than any other variety (11.84 as against 5.86 for Local). Despite this an excellent yield was obtained.

No varietal differences in resistance to *Lygus* and *Helopeltis* attacks were recorded and neither pest was prevalent enough to effect yields seriously.

DISTRICT VARIETY TRIALS.

Eight trials were conducted in Buganda Province; each trial consisted of a 4'×4' Latin Square with the following varieties:—Local, S.G.23/8, B.P.50 and B.P.52.

The results showed no difference in yield of seed cotton between any of the varieties, although there were indications that B.P.50 gave a higher yield of lint per acre than the other three varieties. The early sown trials yielded well and the average yield per acre over the whole series was 820 lbs. seed cotton, which compared with the average yield for the whole of Buganda of under 400 lbs. per acre. This low average yield could be brought up to the variety trial average by improved cultivation, *i.e.*, close spacing, filling of gaps and early planting.

Blackarm counts were made at all centres and both B.P.50 and B.P.52 had more lesions per plant than Local. There was interaction between centres and infection, the trial at Kitale having more Blackarm than any other centre.

VARIETY AND SPACING TRIAL.

A combined Variety and Spacing trial was carried out at Bukalasa with B.P.50 and Local as the varieties, and 4'×1½' and 3'×1' as spacings.

The closer spacing gave a significant increase in yield over control (4'×1½'), irrespective of variety, but there was no difference in yield between the varieties. There was a significant interaction between variety and spacing for Blackarm, as B.P.50 had less Blackarm than Local at the closer spacing. Irrespective of variety, the number of lesions per plant was greater with the close spacing than with control.

BROKERS' REPORTS AND SPINNING TESTS.

Through the kindness of the Indian Central Cotton Committee, the Shirley Institute and Messrs. Wolstenholme and Holland, Spinning

Tests and grading were carried out on a number of samples submitted from Bukalasa.

In the brokers' tests B.P. 50 was judged the best sample while as usual S.G.23/8 was penalised, being 30 points lower than Local at Bukalasa. At Mukono however, S.G.23/8 was given 20 points on Local. The Indian Central Cotton Committee's grader gives the same staple for B.P.50 and Local—this is very surprising as local opinion gave B.P.50 at least $\frac{1}{8}$ th inch longer than local cotton. In the spinning tests B.P.50 failed, largely on its bad appearance on the black-boards. Both B.P.50 and B.P.52 produced very much stronger yarns than Local, but they suffered from neppiness. S.G.23/8 is again the best cotton from a spinning point of view. Local Buganda cotton still spins comparatively well despite its short and irregular staple. There was nothing to choose between the varieties in respect of percentage of waste. The Indian tests showed Local to be superior to B.37 (parent of B.P.50) as regards yarn strength and appearance.

The measurable hair characters show B.P.52 to have the lowest hair weight of any of the samples, but as this is correlated with a high percentage of immature hair the neppiness of the sample is explained. Judging by these characters B.P.50 should have been equal to S.G.23/8. Some other factor must be operating to spoil the former variety.

EXAMINATION OF SEED COTTON SAMPLES.

The routine examination of samples of seed cotton from selected ginneries was carried on. The outstanding feature was the shortness of the Buganda staple; as this is coupled with an improvement in regularity it is possible that the crop is becoming stabilised at about 27 mm. Certainly the number of long linted plants is becoming less every season.

OTHER COTTON EXPERIMENTS AT BUKALASA.

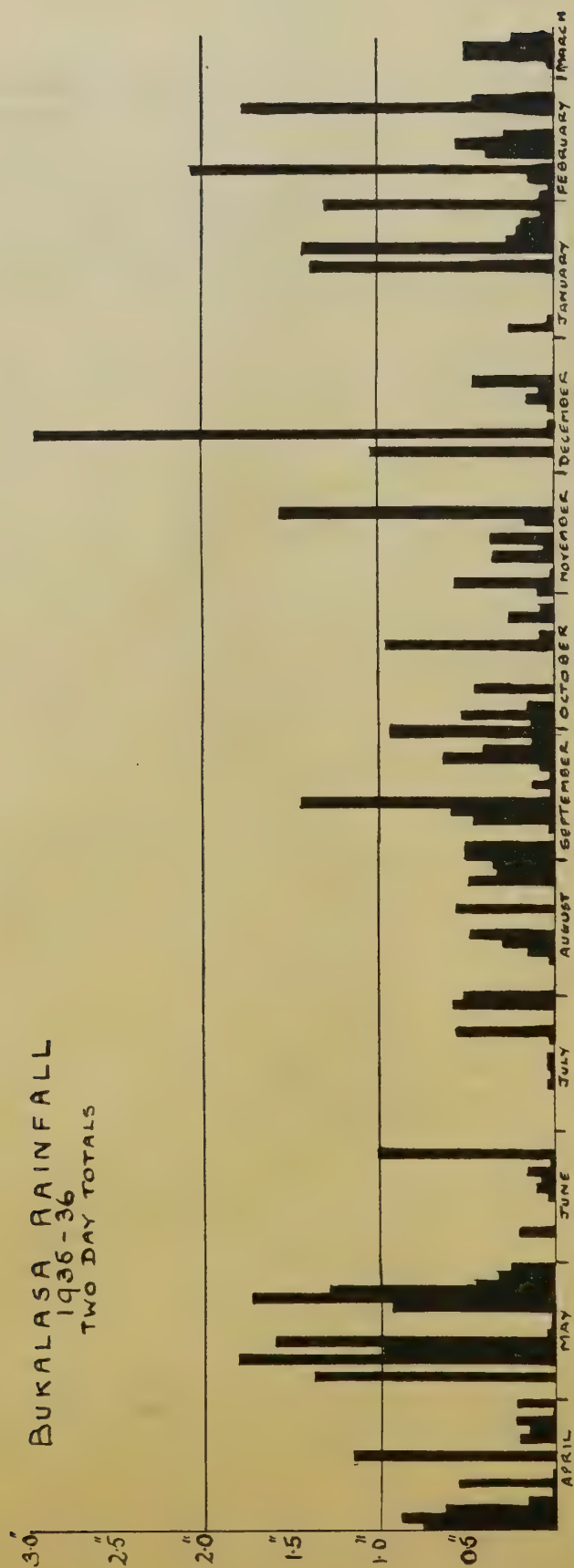
Tests of the residual effect of Elephant grass mulch and green manures, using groundnuts followed by cotton as index crops, gave negative results.

Manurial Experiment.—The value of cotton seed as a manure for cotton was again demonstrated, but green manuring, as usual at Bukalasa, had no effect other than to decrease the germination.

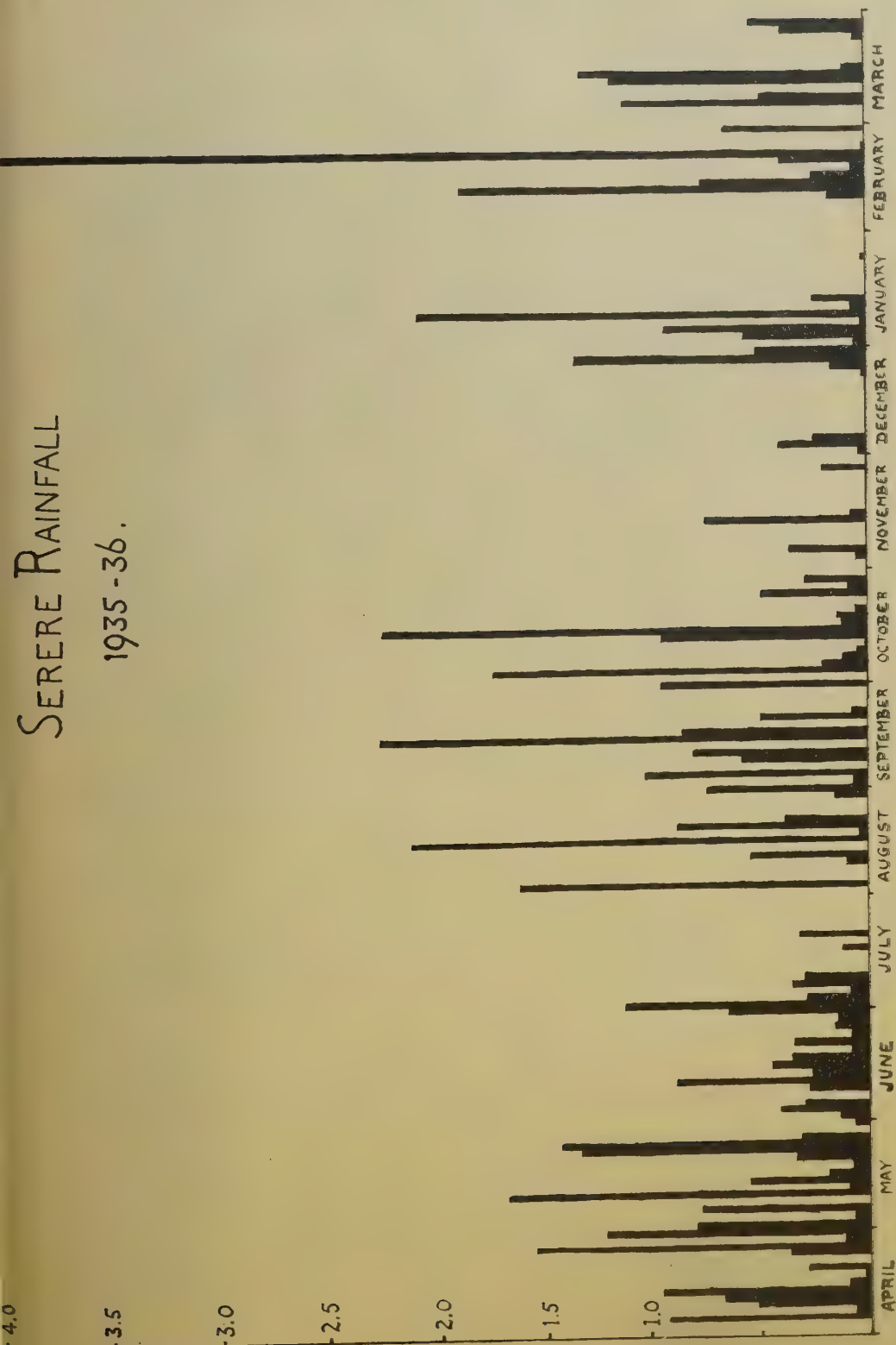
Interplanting Experiment.—Interplanting cotton with beans and/or groundnuts is commonly practised by the Baganda. Experiments show that one row of beans or groundnuts has no deleterious effect on the cotton and has the advantage of producing extra food without the expense of clearing another plot. It would appear that two rows

of inter-plants have some slight depressing effect on the cotton yields.

Rotation Experiment.—A start was made with this experiment the object of which is to ascertain the minimum period under Elephant grass necessary to rehabilitate the soil. The common local rotation is being used, viz. cotton followed by groundnuts, and cotton followed by cotton interplanted. After 3 years of cultivation the land is planted with Elephant grass and left for periods of 2, 3 and 4 years respectively.



SERERE RAINFALL
1935-36.



SERERE ZONE.

BY

H. R. HOSKING.

METEOROLOGY

Weather conditions at Serere and in Teso District were such that abnormally high yields were obtained from May and June plantings, while late plantings gave poor yields.

The rainfall for the year 1935 was almost 4 inches below the fourteen-year mean. July and August were abnormally dry, checking Blackarm development, but spoiling late planting. A remarkable feature was the association of high air temperatures with sub-normal sunshine. The picking months were abnormally wet and much of the cotton was rain-stained.

WEATHER CONDITIONS.

Month.	Rainfall.	Sunshine.	Air temperatures.	Remarks.
1935.				
April ...	Over 2 inches below average.	Above average.	Slightly above average.	Hotter and drier than normal.
May ...	Over 1 inch above average.	Much below average.	Below average.	Wetter and cooler than normal, ideal for cotton planting.
June ...	Over 1 inch above average.	Much below average.	Above average.	Ditto.
July ...	Over 3 inches below average.	Much above average.	Much above average.	Too hot and dry for successful cotton planting.
August ...	Slightly above average.	Above average.	Much above average.	Rainfall good for cotton planting, but days very hot and sunny.
September ...	$\frac{1}{2}$ inch above average.	Average.	Above average.	Rainfall slightly above average but very hot.
October ...	$\frac{1}{2}$ inch above average.	Slightly above average.	Above average.	Ditto.
November ...	2 $\frac{1}{2}$ inches below average.	Below average.	Very much above average.	Very dry and very hot; resulted in early and rapid maturity of cotton bolls.
December ...	Over $\frac{1}{2}$ inch above average.	Below average.	Much above average.	Some cotton rain-stained but weather still hot.
1936.				
January ...	Over 3 $\frac{1}{2}$ inches above average.	Just below average.	Much below average.	Very wet and cold; large amount of secondary growth; cotton badly rain-stained.
February ...	Over 6 inches above average.	Very much below average.	Much below average.	Ditto.
March ...	Over 2 inches above average.	Average.	Above average.	Rainfall irregular distribution; some very hot spells.

BREEDING WORK.

The Breeding Plot comprised 14 Pedigree Lines, 75 New Selections of U.4 origin, 74 New Selections of Nyasaland Upland origin, 32 re-selections from Trinidad hybrids and 18 Serere hybrids in the F₁ generation.

Very high yields were obtained and this fact, combined with the large amount of material, made it necessary to discard drastically. The large turn-over of material made it possible to select rigidly against Blackarm and jassid; it was not found possible to select against *Lygus* and *Helopeltis*.

From the points of view of lint length and Blackarm and jassid resistance, S.P.102, derived probably from a hybrid between S.G.29 and some cotton unknown, was outstanding. S.P.90, derived from U.4/4/2, gave the highest yield, although the ginning outturn was lower than the average for cottons derived from this source. S.P.92, derived from U.4/4/2, gave the second best yield, lint as long as S.P.102, and a high ginning outturn, but showed slight susceptibility to jassid. B.P.50, from Bukalasa, gave long lint, very low ginning outturn, the lowest yield, was resistant to jassid, but was very susceptible to Blackarm. Four re-selections were made from B.P.50 for resistance to Blackarm. S.P.93, Nariama strain, showed little improvement on its immediate parents, except that it appeared to be slightly more resistant to jassid.

The F_1 generation from the hybrids made at Serere in the previous season gave some interesting results. Elements of S.G.23 & 8 increased susceptibility to jassid in all instances. In the same way elements of S.G.29 increased susceptibility to Blackarm. The results obtained showed the necessity for making reciprocal crosses between any given pair of elements; for example, the habit of the female parent was dominant in most hybrids, and there were significant differences in lint length between reciprocals.

Another interesting point was that F_1 's derived from two Blackarm-resistant parents showed greater susceptibility than either parent. This emphasizes the necessity for sustained re-selection against Blackarm, because deterioration is likely to set in as soon as open crossing is permitted in the field.

The lint quality of S.G.29 showed an improvement over the previous season; this may be attributed to a year of high yield under good conditions. S.P.84, although not placed above S.G.29 by local lint buyers, was still placed close to it and above the general run of U.4/4/2 derivatives. S.P.87, on the other hand, produced lint far inferior in quality to that of the previous season—a disappointing result in view of the fact that it had already been planted up for increase.

FIELD EXPERIMENTS.

1. *Combined Variety, Spacing and Sowing Date Trial—Serere.* This was conducted on the same plan as the large experiment of the year before, substituting Spacing for Dusting.

Treatments :—

Sowing Dates.	May 1st.	May 31st.	July 1st.	August 1st.	Varieties.	S.G.29—Control.
						S.P.20.
						S.P.43.
						S.P.48.
						S.P.56.
						S.P.72.
Spacings.	$3' \times \frac{1}{2}'$	$3' \times 1'$	$3' \times 1\frac{1}{2}'$			

Results :

(a) *Varieties.*

S.P.48, S.P.20 and S.P.43 constituted a first group.
S.P.72 and S.P.56 followed in a second group.
S.G.29 was the lowest yielder.

(b) *Sowing Dates.*

The yields were in descending order by sowing dates, the August sowing yielding only just half the yields of the three earlier sowings.

(c) *Spacings.*

No differences.

(d) *Interaction of Sowing Date and Spacing.*

Close spacing compensated to a small extent for late sowing, but the effect was not at all marked.

(e) *Interaction of Variety and Sowing Date.*

The U.4/4/2 derivatives definitely favoured early planting, whereas the Nyasaland Uplands favoured the second and third sowing dates; S.P.56 was unduly depressed in the third and fourth sowing dates.

Once again this lay-out gave most satisfactory results, and quite small differences were detected as significant.

2. *Miniature Variety Trial—Serere.* This experiment consisted of 13 varieties replicated 10 times in random blocks. Each "plot" consisted of one row of 50 plants at 3' $\times$ 1' spacing.

The object was to test a number of strains of which insufficient seed was available for inclusion in the larger trials.

It should be noted that comparisons of yields are of doubtful significance, owing to the competition of large vegetative strains when grown side by side in single rows with small sympodial strains.

The figures for disease and insect attack were of great interest and the above criticism does not apply. In fact if jassids are found to be more numerous on individual rows of any one strain scattered over the experiment, one concludes that these insects have a definite preference for that strain. The outstanding results were :—

- (1) Blackarm lesions: all varieties much more resistant than control—S.G.29.
- (2) Yield: All varieties gave much higher yields than control—S.G.29. Increases ranged from 19% to 84%.

3. *District Variety Trials.* Twelve 4 $\times$ 4 Latin Squares of the same four varieties were scattered over the area east of the Nile.

Results :

The general mean for yield over the whole series was 911 lbs. of seed cotton per acre. At this very high level differences between varieties tended to flatten out.

Over all centres combined, S.P.20 (U.4/4/2) was better than S.P.72 (Nariama Strain) was better than N.17 (formerly the standard variety throughout and still standard in Busoga and Lango Districts), was better than S.G.29 (new standard variety in other districts).

The Interaction of Variety and Centre was highly significant. N.17 gave very much better yields than S.G.29, except in Busoga and Lango where there was but little difference. S.P.20 had a smaller advantage over the two standard varieties in Busoga than elsewhere. S.P.72 did very poorly in Busoga, but quite well elsewhere.

The failure of S.G.29 relative to N.17 was even more marked than in the previous season.

In addition to the above, three varieties (N.17 omitted) were randomized over five blocks at three centres across the light soil

areas in Usuku and Kumi Counties of Teso District. The yields were again very high and S.P.20 and S.P.72 both did better than S.G.29.

4. *Manurial Experiment—Serere.* The experiment described in last year's report completed its first cycle with a crop of groundnuts. There were no significant differences in the yields of groundnuts, but over the whole cycle the lime treatment had a depressing effect, there being no differences between the other treatments.

COTTON SEED MULTIPLICATION.

In view of the rapid deterioration of S.G.29, the strain S.P.87 was run up in the 3-acre stage direct from the breeding plot. The 40-acre farm was planted with S.P.20 and yielded an over-all average of 863 lbs. of seed cotton per acre—the highest yield of cotton ever obtained at Serere. The early sown blocks yielded just over 1,100 lbs. per acre.

328 acres at Mulondo were planted with S.P.1, the first crop of U.4 to be grown by natives in Uganda. A very high proportion of the crop was planted late and failed owing to dry weather. In the circumstances the over-all average yield of 372 lbs. of seed cotton per acre was very gratifying.

The other Segregated Areas were re-supplied with S.G.29 and there were no distributions to other districts.

SPINNING TESTS & BROKERS' REPORTS (1934/35 CROP).

Pairs of S.P.20 and N.17 and of S.P.20 and S.G.29 from the district variety trials were submitted to the Shirley Institute, Didsbury. In general the card room and blow room losses were least from N.17, intermediate from S.P.20, and greatest from S.G.29. In yarn appearance the varieties were placed in the same order, S.G.29 being poor and very neppy.

The same varieties, from variety trials in Busoga District, were submitted to the Indian Central Cotton Committee. The card room and blow room losses were in the same order as those from the samples sent to Didsbury. In spinning performance N.17 was placed above S.G.29, which in turn was placed above S.P.20, with however the qualification that the advantage of S.G.29 over S.P.20 was not as great as would have been expected from the fibre properties. On a basis of Rs.208, N.17 was given Rs.127 on, S.G.29 Rs. 130 on, and S.P.20 Rs.133 on. It was interesting that S.P.20 was attractive from a broker's point of view.

Through the courtesy of The Liverpool Uganda Co., Ltd. a report was obtained on one bale of lint of S.P.20 produced on Serere Farm in

the 1934/35 season. Low card room and blow room losses were again noted.

In the 1935/36 season twenty one bales of lint of the same variety were produced on Serere Farm. The cotton was ginned by East African Ginneries Ltd. and gave an outturn of over 36% under commercial conditions. A sample of lint was then submitted to The Liverpool Uganda Co., Ltd. who reported as follows :—

“ We are attracted by the style of the cotton, though of course the staple is both shorter and weaker than ordinary Teso. in our opinion it is certainly cotton which should be readily saleable in Lancashire, probably more so than the present cotton (S.G.29) which is only sold in competition with Egyptian.”

[Included by courtesy of the Tanganyika Government.]

TANGANYIKA TERRITORY.

UKIRIGURU EXPERIMENTAL STATION, AND NYAMAHONA SEED FARM, PROGRESS REPORT FOR THE SEASON 1935-36.

BY

N. M. WIGHT.

General.—General weather conditions during the year under review were very satisfactory and high yields of all crops were obtained. The early and careful clean up of all crop waste from 1935 considerably reduced the incidence of pests and diseases to the advantage of the 1936 crops.

Cotton.—Nineteen strains, selected in 1932 from the district cotton, were tested in three strain trials. A few of these again show promise and have proved to be significantly higher yielders than the control. One strain, No. 561, of particular interest as far as yield is concerned, has always headed the list. This year it gave a mean yield of 800 lbs. seed cotton per acre compared with 616 lbs. per acre from control, the difference for significance being 161 lbs. ($P=0.05$). It has a mean lint length of $1\frac{3}{16}$ ins. and a ginning percentage of 34.5.

Selection work has been continued as heretofore and there are several new strains ready to take the place of those which can now be discarded from the strain trials.

In a variety trial U.4/4/2 and two mass selected mixtures from the local cotton were tested against the district seed. Although both mass selections gave a greater mean yield than control, none of the treatments were significant. U.4/4/2 is the cotton of the adjacent Shinyanga district where it has already proved itself. In the area served by this station, however, it has never been found to be statistically superior to the local cotton.

Some hybrids received from Nyasaland were planted in isolated observation plots. Some of these show promise, especially "Over the Top" $\times$ S.G.27.

A time-of-planting experiment showed that the optimum planting date in this area is somewhere between the middle of November and the end of December. The year was one with a good late rainfall

and it is surprising that the late plantings, in January and February, did so badly. Planting was carried out irrespective of soil conditions, in fact the early plantings were done in bone-dry soil. The mean yield of plots planted on the 30th November was 806 lbs. per acre compared with 180 lbs. from plots planted on the 15th of February; the difference for significance being 151 lbs. ($P=0.05$). Once the soil gets really wet and "cold", as is normally the case in January and February the young seedlings make slow growth, whereas the early planted seedlings have made good growth before sodden conditions set in.

In a plant stand trial no significant difference was found between leaving two, three, four and five plants per hole. All spacing was uniform at $1\frac{1}{2}'$ by $3'$.

There is a considerable amount of a fertile heavy black soil in this district, but it has been found that cotton never does well on these soils; the plants grow well, but very few bolls are produced. In an experiment four treatments of such a soil were tried, but all were a complete failure and no crop was picked. The treatments were (1) Planted on ridges; (2) Planted on the flat; (3) Dressing of 3 tons per acre of farmyard manure before planting; (4) Green manured with sunnhemp dug in before planting.

Rotational Crops—Sorghums.—The year was one especially favourable for sorghums and several varieties gave yields of over a ton of grain per acre. Four variety trials in which twenty-five native sorghums were tested have again proved the superiority of certain varieties. Nzanza, a quick maturing short sorghum has given high yields and shows promise; the grain is not however very well liked by the natives. Selection work is now being started within the most promising of our varieties.

In a spacing trial the following results were obtained:—

						Mean Yield (lbs. per acre)
(a)	Rows $1'$ apart, plant $1'$ in row	...	...	...	...	2,275
(b)	2' 1'	...	...	...	...	2,381
(c)	3' 1'	...	...	...	...	2,529
(d)	4' 1'	...	...	...	...	2,153
(e)	5' 1'	...	...	...	...	1,836
(f)	Broadcast, native method	...	...	...	...	2,356

The difference required for significance is 456 lbs. ($P=0.05$) this is high on account of the great variation in plot yields within each treatment.

Groundnuts.—In a variety trial no significant difference in yield was found between Barberton, Manyema, Virginia Bunch, Mwitunde and local district seed. In previous years interesting results were

obtained from the spacing and weeding experiment on the incidence of rosette disease. This year, however, owing to the low incidence of rosette throughout the farm, no significant results were obtained from any of the treatments. Some of the single plant selections from the native crop have proved interesting and these are now being tested in strain trials.

Minor Crops.—No results have as yet been obtained from the attempt to raise mosaic-resistant strains of cassava from seed. In general, however, plants raised from seed go down to mosaic much later than do cuttings, and it seems possible that the former may give higher yields. Under conditions here there seems to be no difference in the rate of maturity between these two methods of propagation. Tepary bean continues to show its value as a quick maturing food crop. Soya beans have been tried, but have been a failure.

Cultural Experiments.—In a densely populated area such as this, where there is little scope for the practice of shifting cultivation, the maintenance of fertility of native holdings becomes a problem of primary importance. To this end a number of manurial trials have been carried out.

The residual effect of a dressing of 1, 3 and 5 tons of farmyard manure applied to pennisetum in 1935 gave no significant increase when planted with cotton this year, although control (no dressing) gave the lowest mean yield. In a similar trial laid down this year, all three direct treatments gave a significant increase in the yield of pennisetum as compared with control. There was, however, no significant difference between the effect of the various applications, *i.e.*, 1, 3 and 5 tons per acre.

A trial of the residual effect of three rates of dressing, 2, 5 and 8 tons per acre of kraal manure applied in 1934 to pennisetum gave no significant results when cropped with sorghum this year.

The alternative method of maintenance of fertility, namely green manuring, has also been tried. The residual effect of sunnhemp, sunflower and bulrush millet dug in in 1935 was tested on cotton this year. Sunnhemp gave a significant increase in yield while sunflower produced a depressing effect and was significantly lower than control (no treatment).

The effect of continued cropping is also being studied by means of exhaustion plots on which the same crop is grown year after year without any attention being given to the upkeep of fertility.

Mixed Farming.—Some 50 head of cattle are maintained on the farm and as far as possible all work is carried out by oxen. Stock feeding is of paramount importance in a system of mixed farming and

we have found that our cattle can be kept in good working condition, with the limited amount of grazing available, by feeding crop residues such as maize stover, groundnut haulms, etc. Their ration is supplemented towards the end of the dry season by silage made from maize and millets. Other very useful fodder crops are elephant grass, Dolichos bean, Ironbark pumpkin, and millet hay.

Ideal Native Holdings.—There are now 7 holdings on the perimeter of the farm. The two original settlers have now obtained imported Victory ploughs and these are proving to be much more satisfactory than their previous wooden ones. They are taking an increased interest in their farms, and they have all produced plenty of food and have in addition received Shs. 30/- to Shs. 40/- from the sale of their cash crops. Their cattle have been maintained in good condition by being tethered on their grazing and by the feeding of crop residues and it has not been necessary for them to grow special fodder crops.

Nyamahona Seed Farm, Uzinza.—Approximately 100 acres of this farm were under cotton; this, however, did badly and was severely attacked by capsid and resulted in only 13,000 lbs. of seed cotton being harvested. Other rotational crops did fairly well, particularly Virginia Bunch groundnuts, from which a yield of 1,300 lbs. of unshelled nuts per acre was obtained.

A considerable increase in clearing has been made and cattle have now been introduced; they have, for the present, however, to be confined to work near the centre of the holding in order to ensure freedom from fly. Eight of the original complement of oxen have been lost owing to fly, but none of the new animals sent towards the middle of the year has as yet been infected. It is expected to have nearly 300 acres under cultivation in the coming season.

There are now approximately 140 settlers on the farm. Their 20-acre holdings have been marked out on the perimeter of the area and in consequence they have had a lot of clearing to do. They have all however obtained sufficient food and when they are properly settled in and have done enough clearing, they will be introduced gradually to improved practices.

A school house has been built and here the settlers will receive instruction in improved farming methods. An African Instructor will be placed in charge as teacher.

LUBAGA EXPERIMENTAL STATION,
PROGRESS REPORT, NOV. 1935—NOV. 1936

BY

J. G. M. KING.

GENERAL.

Throughout the year the consolidation policy of the farm was continued. Capital improvement and anti-erosion work took priority. The work comprised that of an Experimental Station, a Native Authority Seed Farm, a Ploughing School, an Agricultural Educational Centre, and focus of Peasant Holdings. Classes were held for the training of the Native Administration marketing staff in the grading of produce and in the conduct of Markets. In addition, a district agricultural show was held.

METEOROLOGY.

This season the rains were late in setting in, and were light at first ; consequently the preparation of land and planting were somewhat delayed. The total precipitation was satisfactory, but its distribution was again spasmodic. February's rain was especially uneven in its distribution, while considerable damage was done to the crops in March by torrential downpours accompanied by high winds.

PESTS AND DISEASES.

During the hot dry spell in February considerable damage was done to the cotton experimental plots by white ants. Nomadic swarms appeared and commenced their ravages in spite of attempts to trap them by baits of fresh cut grass. The damage was lessened by building up small ridges at the base of the plants. Fortunately the rains in the beginning of March terminated their activities. In April and May severe boll-shedding due to American bollworm was recorded among all the cottons ; towards the end of May a secondary shedding resulted from a less severe attack of Spiny bollworm. On four fields of the farm in which U.4/4/2 and 955 were growing the boll shedding was so severe that it reduced the bolls per plant to three or four. It is interesting to record that these cottons put on a good top crop in the later part of the season and produced 361 lbs. and 291 lbs. of seed cotton per acre, which in these circumstances can be regarded as remarkable, especially so in view of a severe infestation of jassid which appeared in early June. In this jassid attack the Mwanza Lake shore varieties

again suffered severely. Adjoining the observation plots of the several varieties "stand-over" cotton from last season was left, with the object of "bombarding" them. The young cottons were attacked as early as mid-March by jassid, and with the exception of some Mwanza Lakeshore varieties, they appeared to suffer little ill effect. Varieties Mwanza 576, 570, 572 suffered severely.

In May a considerable amount of damage was done to the sorghums by a long-horned grasshopper *Homorocoryphus vicinus*.

EXPERIMENTAL WORK.

Cotton.—The cotton work was again divided into two sections—(a) Comparative, (b) Observation and selection work.

Variety Trial.—In the main variety trial, U.4/4/2 was used as the control and was compared with the latest U.4 selections from Barberton and with the Uganda Upland varieties from Ukiriguru. The trial consisted as in 1935 of 13 varieties replicated 6 times.

- i. Barberton 921, 920, 955, 998, U.4/4, U.4 Bulk, 9264R, 935R.
- ii. Control U.4/4/2.
- iii. Mwanza Bulk.
- iv. Ukiriguru 561, 572, 570.

Results, 1935. 998, 921, 920, U.4/4, 955, were all significantly greater than control U.4/4/2. *Results, 1936.* Using U.4/4/2 as the control which yielded 588 lbs. of seed cotton per acre, 998 again gave a significant increase, and yielded 668 lbs. of seed cotton per acre. 921 and U.4/4 maintained an increase, but were not significantly greater. U.4/4/2 was significantly greater than Mwanza Bulk, and Mwanza 572.

In a variety trial comparing 998, U.4/4/2 and Mwanza Bulks, both U.4/4/2 and 998 showed increase over the Mwanza lake shore cotton, but the increases were not significant.

Time of Planting.

A time-of-planting trial was carried out, covering a range of time from the beginning of December to the middle of February. The layout was, a 6×6 Latin Square. Variety of cotton U.4/4/2.

Results:

Sowing Date.				Yield per acre.	Difference required for significance in lb. per acre.
December 1st	...	...	...	805 lbs.	214 lbs.
December 15th	...	...	...	845 lbs.	
January 1st	...	...	...	807 lbs.	
January 15th	...	...	...	310 lbs.	
February 1st	...	...	...	192 lbs.	
February 15th	...	...	...	117 lbs.	

December 1st and 15th and January 1st were significantly better than the other later dates.

Cultivation Experiment.

A cultivation experiment was carried out to ascertain the difference in yields between flat and ridge method of growing cotton; also the effect of deep hoeing versus shallow hoeing during period of growth.

Layout. Randomised block: 4 Treatments, 6 Replications.

Treatments.—i. Flat and deep cultivation. ii. Flat and shallow cultivation. iii. Ridge and deep cultivation. iv. Ridge and shallow cultivation.

Results.—No significant difference between treatments.

Number of Plants per hole.

Two experiments using different planting spaces were carried out to ascertain the effect on ultimate yield of increasing the number of plants per acre. Two common planting distances in native cultivation were used.

Experiment "A" 3 feet by 3 feet. Experiment "B" 3 feet by 1½ feet. Layout. Randomised block. 6 Replications.

The treatments were:—1, 2, 3 and 4 plants per hill.

Results.—This experiment was damaged by white ants early in the season. The stands were not uniform, but on analysis both experiments gave a strong indication that two or three plants per hole give a considerable increase in yield.

(b) *Observation and Selection Work.*—Observation plots of one-sixth of an acre were laid down, and a comparative study was made of various selections from Barberton, Gatooma, Ukiriguru, and Nyasaland. Single plant selections were made from some of the above and from the district cotton. The 1935 single plant selections in their progeny plots were severely damaged by bollworm and had to be bulked together in their respective varieties. Selections from 998, 920, and 921 showed signs of promise. Field scale trials of the following varieties yielded as under:—

Variety 998	...	Yield in lbs.	Seed Cotton per acre	580
" 955	...	" "	" "	291
" U.4/4/2	...	" "	" "	361
" U.4/4	...	" "	" "	216
" U.4 Bulk		" "	" "	343

(c) *Demonstration Work.*—Several interplanted observation plots of cotton were planted. It was desired to find out the effect of interplanting certain crops and the practicability under local conditions. Other demonstration plots were planted to illustrate to the natives the undesirability of certain practices which they wish to adopt.

1. Cotton interplanted when six inches high with pigeon-pea. This was designed to ensure that the land would be rested in the second year from cotton. Cotton planted 3 × 3 feet.

Results. Yield 390 lb. cotton. Pigeon-pea negligible.

2. Cotton interplanted with Virginia Bunch groundnuts. This was designed to increase the output per acre compatible with sound agriculture.

Result. Yield. Cotton at the rate of 422 lbs. per acre. Groundnuts 840 lbs. per acre.

3. Pennisetum interplanted with cotton. This was planted to demonstrate the undesirability of interplanting cotton in tall-growing cereal crops in this area, a practice

which the native continually asks to be allowed to adopt. The result convinced and impressed the native visitors.

Yield. Pennisetum 926 lbs. per acre. Cotton 120 lbs.

DEMONSTRATION WORK.

Timing and exhaustion plots of cotton, sorghums and groundnuts were laid down this season. Many demonstration plots were planted; these were comprised of simple rotational plots, various methods of ridge cultivation to show anti-erosion measures, and exhaustion plots. All had direct bearing upon the local agriculture of the district and great interest in them was shown by the natives. The following yields were obtained from the exhaustion plots.

Cotton	...	...	...	521 lb. per acre.
Virginia Bunch Groundnuts	...	...	...	1,083 lb. per acre (unshelled)
Sorghum	...	...	...	784 lb. per acre.

THE SEED FARM.

The farm was run in conjunction with the Experimental Station, and cattle were used as much as possible. This Farm, apart from providing considerable quantities of good seed for distribution purposes, enabled the natives to see the basis of the extension work, and the introduction of mixed farming into their country. Experience gained was of great assistance in forming the policy and deciding the nature of work for the demonstrational peasant farmers.

Multiplication of Seeds.—Quick maturing varieties of seeds were again grown for distribution. *Feterita* sorghums, Virginia Bunch groundnuts, awned bulrush millet, Kenya hybrid maize, and quick maturing native maize formed the basis of the work.

Education.—The farm is gradually becoming an agricultural centre for the neighbourhood, and it is pleasing to record that a greater number of natives visit it annually, and take particular interest in the working of the cattle. Throughout the year evening classes were held twice weekly for those natives who wished to attend. Several applications have been received already by natives wishing to enter the adult school. The school is intended to meet the needs of illiterate natives who are desirous of becoming better agriculturalists. Facilities will also be provided for teaching them to read and write, and it is hoped to arranged separate classes for their women folk in domestic economy and in the elementary principles of hygiene. A month's course of training was held during the year for the African instructor staff and for the Native Administration market staff. The benefit of this course was reflected in the running of the markets, later in the season.

Ploughing School.—During the later part of the season the facilities provided by the ploughing school came into considerable demand.

Many natives sent in their oxen for training, and a number of natives were assisted in the purchase of their ploughs.

Stock.—The feeding of the stock received considerable attention, as it forms one of the fundamental points in mixed farming. The problem can be divided into (a) the maintenance of stock in good condition under the existing conditions and requirements of a peasant farmer and (b) their maintenance in good condition under the more arduous conditions of a large seed farm. As regards (a), it was found possible to keep stock in excellent condition by feeding them on the residues of the cereal crops, and on the tops of groundnuts, together with the grazing. As regards the farm stock very satisfactory results were obtained by feeding them in the early part of the dry season with elephant grass or canna and cotton seed, while in the later part silage was substituted for the green fodder. In spite of extremely hard work such as dam and tank construction, the beasts were maintained in good condition.

Labour.—During the latter part of the year it was decided to erect a central cook house and to provide the casual labour with two well cooked meals per day in an endeavour to popularise work and to see if better work could be obtained from the labour. Results to date are very gratifying as there has been no labour shortage compared with the same period last year, and moreover the natives appear to be capable of working efficiently up to knocking-off time. The natives are fed, prior to the commencement of work in the early morning with hot bean soup, and again at 12.30 with hot maize or muhogo flour, together with the residues of the beans. The ration of salt is mixed in with food.

PEASANT HOLDINGS.

The two peasant farmers continued throughout the year on the demonstration holdings, on the lines indicated last year. Domestic troubles were responsible in both cases for the poor returns which they obtained. Their cleaning operations were hindered, with the result that the yields of their food crops were poor. Satisfactory yields were obtained from their cotton crop, however, which will enable them to tide over their difficulties. One farmer obtained about Shs. 76/- for his cotton, while the other received Shs. 90/-. Great care is being taken to explain to them the necessity of wise spending and of building up a cash reserve. A third peasant farm was established at Ibadakuli during the year and satisfactory food and cash returns were obtained. This farm was of considerable interest to those who attended the Agricultural Show.

CAPITAL IMPROVEMENTS.

Considerable capital improvement work was continued during the year. This included the continuation of the anti-erosion works and the building of the adult school.

Anti-Erosion Work. I. *Windbreaks.*—Windbreaks of *cassia simea* were planted to form a large letter H. They consisted of five rows of trees with *Euphorbia* hedges on either side. These windbreaks were a complete failure owing to the unfavourable conditions. The *Euphorbia* established itself satisfactorily and will afford excellent protection for the young trees which will be planted during the coming season.

II. *Anti-Erosion Banks and Drains.*—Over a hundred acres of the farm were safeguarded by means of banks and drains, laid out on the Havilland system. These banks were placed at every one-and-a-half foot vertical fall, while the banks themselves had a discharge fall of one in four hundred. The system was tested severely in February and proved itself very satisfactory. An additional advantage of the system was that it enabled the water to be controlled and directed into the open catchment tank. This tank was invaluable during the dry season for the provision of water for the farm.

Building Work.—(a) *Model Native House.*—A model native house was built on the station, with the object of demonstrating a simple yet hygienic dwelling. It consisted of a three-roomed house with verandahs back and front, built of mud brick with “Colas” ant-proof courses, and floors of similar material.

(b) *Adult School Buildings.*—A lecture hall was built to the plan of a standard Native Administration Courthouse. The fabric is made of cement blocks with a roughcast exterior, while the roof is of thatch, attractively done in the old Sukuma style. The accommodation for the pupils consists of rondavels built of mud brick with thatched roofs, with colas ant-proof coursing and floors.

(c) *Water Conservation.*—A second and larger open catchment tank was constructed during the dry season with ploughs, dam scoops and oxen. It is interesting to record that these tanks have made a considerable impression on the Chiefs of the District, as a means of solving their water shortage. Several requests have been made to mark them out in various areas in the district. In addition to this catchment tank, work was commenced on a large dam at the bottom of the farm. The water from the anti-erosion banks will be directed into this dam and will be conserved for stock purposes.

Sundry other capital improvement works were carried out which included the building of a permanent maize crib, central cook house,

headmen's quarters, hen houses, and manure pits. Structural alterations were made to the ensilage pits; a long channel type was made to enable the carts to be driven in and out when filling it.

MOROGORO AGRICULTURAL STATION AND
KINGOLWIRA EXTENSION FARM AND
SETTLEMENT CENTRE:
PROGRESS REPORT FOR THE SEASON 1935-36

BY
N. V. ROUNCE.

MOROGORO AGRICULTURAL STATION.

Experimental Work.—Fifteen field experiments were planted this year. With the exception of cotton strain trials, these were directed towards the solution of various problems either peculiar to the Eastern Province, or to problems which will arise in due course in the development of mixed farming in this area, and in particular at Kingolwira.

(a) *Cotton Selection Work.*—It has been a poor year for cotton planted close to the mountains everywhere in this district, and particularly so at Morogoro. The mists and sudden drops in temperature appear to be very suitable for the development of *Helopeltis*, an insect which has been very widespread and persistent this year. It was the principal cause of the low yields of cotton, coupled with the excessive rain. However, last year's results in the introduced strain trials have been corroborated; 998, U.4/4/2, U.4/2 and 955, being the highest yielders. 998 has shown an increase over local cotton of 177% and 108% respectively in the last two years. Of the above, 998 has the best lint qualities, though they are barely up to the minimum standard required. Brokers' reports class it as good middling, medium-strong, with a premium of only 50 points on; whilst the parent U.4 has better lint qualities than any of its derivatives, its yield this year is only just superior to the local type. It is stated that 998 would receive some 1-1½ cents per pound of seed cotton less than is now obtained in the district and, while it is questionable on the one hand whether the change

would justify the hazard involved in entering a new and bread-and-butter market, there is at the same time a temptation to take advantage of the greatly increased yield and ginning percentage, though extensive trials would still have to be made in the district. None of the selections from "local" has shown satisfactory superiority, though some received from Uganda are behaving promisingly.

(b) *Trials relating to local problems.*—1. Cultivation methods.—With the higher rainfall and different soil conditions and altitude, local native cultural operations are bound to differ from those of the drier inland plateaux and cultivation steppes, but it is considered that the former practices are in many ways primitive and based on less sound foundations. Evidence in support of this belief is forthcoming from the results detailed below of a comparison of cultural methods wherein superficial hoeing shows a 56% increase in yield over the native method :—

	<i>Lbs. per acre of maize.</i>	<i>Difference required for significance.</i>
Native method (destruction of weeds and planting on unhoed ground)	766	
Ridging method (weeds turned under)	1,034	
European method (weeds destroyed and soil hoed 3" deep)	1,199	244 lb.

Spacing practice.—The spacing of sorghum and maize in the district also appears to be unsound. The normal spacing of maize, 4'×1' single plants per hole, gave a 20% increase in yield over the native practice of 4'×4' with five plants per hole.

Variety trials.—For the second year in succession the sorghum variety "Kobero" has headed the list, principally owing to its bird-resisting properties (in spite of the whole experiment being defended from birds as far as possible) and large size of panicle. Attention will be paid to its distribution in the district. Numerous varieties have also shown their worthlessness. The trial of sweet-potato varieties also gave most interesting results. The yields of 12 local and 4 introduced varieties varied from 6½ tons per acre to as little as 1½ tons per acre of roots, whilst the best varieties, with the exception of a simple-leaved introduction from S. Rhodesia, all bore deeply divided "Bird's foot" leaves, but gave the least yields of fodder in the form of haulms. Such considerable variation in the yields of local varieties gives encouragement to the work of eliminating the poorer types from the agriculture of the natives. The cassava variety trial is not yet mature whilst the cowpea trial was a failure.

Cassava tolerance to mosaic disease.—On the assumption that the 1-100,000 chance may be liable to occur within a period of years, large quantities of cassava seed have been inter-sown between rows

of diseased setts. Exceptionally good germination was obtained and many of the seedlings are still free from disease. It is fully realised that no indication, even tentative, can be expected until the seedlings have been exposed to infection for a period of years and for this reason over 100 seedlings which had been exposed for $1\frac{1}{2}$ years without becoming infected have been replanted again in progeny plots with surrounding infected rows.

Cotton.—Other interesting experiments relating to the following cotton problems gave no yields worth harvesting:—(a) Viability and vigour of plants from 1st, 2nd and 3rd grade cotton seed. (b) Interplanting of maize. (c) Number of plants per hole and ridge v. flat cultivation.

Green manuring.—Local native practice does not involve the turning in of weeds, and in the event of the introduction of this practice being insufficient to maintain fertility it was desired to ascertain whether the digging under of a green manure crop like Sunn hemp would suffice, if cattle keeping was impracticable.

	Pounds per acre of <i>Pennisetum</i>	Difference required for significance.
Native practice	416	214 lbs.
Weeds dug in	513	per acre
Sunn Hemp dug in	726	

This records an increase of 76% in lbs. per acre of *Pennisetum* from an application of Sunn Hemp two months before planting.

(c) *Problems relating to mixed farming.*—The only applications of farmyard manure or compost which gave significant increases in yields of maize were 2 tons of cotton-seed compost and 6 tons of farmyard manure. The negative results of the past year are by no means conclusive, however, as increased yields are often reaped in the second and following years after application. It was thought, however, that the 2- and 4-ton applications of the different composts would benefit the crops in the first year.

The Dairy Herd.—This herd has become of importance to the development of Kingolwira as the nucleus of its future breeding stock. In the first place the herd was composed of half-bred Friesians and Ayrshires with a three quarter-bred bull. Since then 15 native heifers have been drafted in with the aim of starting up a native herd at Kingolwira when the time is propitious. Surprising improvements in both condition and milk yield have been obtained from the careful feeding of native stock, as have been reported from other stations. The herd totalling 50 beasts over a year old has been kept for the last two years on 17 acres of arable land and 4 acres of grazing, with some roughage from the experimental plots.

A compost factory is run in conjunction and produces about 150 tons of compost per annum at a cost of about 2s. per ton. In this way all the waste products of the experimental farm are made use of and turned either into milk or manure.

KINGOLWIRA EXTENSION FARM AND SETTLEMENT CENTRE.

About 5 square miles of land have been cleared or thinned of bush. The operation "thinning" involves the stumping of all species, except the *Acacia pallens* and a few of the very largest of the other species. It was thought that this might be sufficient to rid the area of fly, and it probably would be efficacious if it were possible to wait long enough. Ten miles of rough road have been made, and two miles of piping laid, whilst the settlement and farm have been cut off from the main fly bush by a complete felled barrier 1,100 yards wide and 4 miles long. All the 30-acre blocks for the farm and 14-acre holdings have been surveyed ready for opening up when required.

Cotton Selection Work.—Yields of each of the 593 local single plant selection progeny plots were weighed separately and yields per plant arrived at. 119 selections are being carried forward to 1937. Their mean yield per plant of 3.12 ozs. compares favourably with the mean yield of all 593 of 2.33 ozs. Three experiments were planted, but without any outstanding success owing to the land being fresh from bush. Of the complex hybrids from Trinidad the following three appeared most suited to our conditions and standards :—

1. "Over the Top" $\times$ ($2 \times 34 \times 59$).
2. U.4 $\times$ "Over the Top."
3. (U.4 $\times$ Cambodia) $\times$ U.4.

The Cotton Crop.—Only a small acreage of cotton was planted on the farm, but all the peasant holders took seed of 998 for planting and are extremely pleased with it. An average of about 477 lbs. of seed cotton per acre has been obtained by them, one holder reaping over 880 lbs. from one acre. Both the farm and settlement are admirably suited to cotton. It has been noticeable this year that the U.4 derivatives have developed a second crop of cotton as the local type does, their supposed tendency to produce one single flush only was considered a very serious drawback.

The tsetse fly position.—Broadly speaking, the measures taken have been to thin the bush in the development area leaving only the shadeless *Acacia pallens* and thickets, and to surround it with a clear felled barrier 1,100 yards wide. To hasten the pushing back of fly, attention is now being paid to the gradual dropping of the remaining standing trees close to the present farm and grazing grounds. A further factor in the

form of *Glossina pallidipes*, distinct from *G. morsitans* (which is the species to which the above measures have been directed) has now put in an appearance; suspected a year ago, but not found after many days of baiting with oxen, it has since spread down the riverine forest belt (which was used as a base line for development, in view of the fact that it offers an effective and natural barrier to *morsitans*) and has infected the herd of oxen with Trypanosomiasis. No oxen have as yet died from disease, however. This new obstacle has been the subject of a visit from the Director of Tsetse Research, by whom recommendations have been made. Fly pickets are stationed at the points of entrance to the farm and regular fly rounds (with ox bait for *G. pallidipes*) are maintained weekly and records kept of incidence of fly. The reduction of game in the clearings has been attended to as it is considered that pig and small buck in the uncleared thickets are the cause of the incidence of fly (low as it now is) around the comparatively clear grazing areas.

The Farm.—It is not yet possible to use the farm for its primary purpose of cotton seed multiplication, so the greater proportion was put down to food crops to feed the labourers, a saving of £100 being made in this way. Excellent yields of groundnuts and tepary beans were harvested, showing profits of 51s. and 30s. per acre respectively. Other crops gave only fair yields, in many cases owing to the planting having been on new land lacking in nitrogen, on account of the large quantities of organic material with a wide carbon/nitrogen ratio left over from the bush, but lately cleared. 289 acres were put under cultivation mostly by hand, but twenty months after the first clearing was begun cattle were being used in ploughs and cultivators, and about 60 acres were contour-ridged with a dam scoop. Costs of all operations were recorded indicating whether certain crops might be profitably cultivated by non-natives.

The Settlement.—(a) *The Peasant holders.*—Unlike Nyamahona, the Kingolwira settlement offers no land of type similar to that to which the natives in the over-populated hill areas are accustomed. Hence, until the settlement has acquired a reputation, it is unlikely that the hillmen will migrate to the plains. The aim has been to provide the 21 settlers who are mostly plainsmen, with good land, fixed holdings, freedom from vermin, good seed, adjacence to water and firewood, easy marketing, and assistance with food till their first crops come in. Care has been taken in selecting the peasant holders (who are quite distinct from the demonstration holders) in order that they may be good propagandists. The first applicants were provided with houses, but the new arrivals this year are provided only with materials and they

must build for themselves. The site is a good one, the development of crops has been excellent and if, as is hoped, the hillmen are attracted the scheme should in due course fulfil its aim of making better citizens and agriculturists of some of the improvident mountain people also. Each plot is divided into its arable section, and 4 acres of grazing sited as far as possible above it to act as an erosion strip. The rotation of crops is facilitated by the planting of the four main crops—sorghum, cotton, maize and legumes—on contiguous acres. A pair of milch goats have been supplied by the Veterinary Department, for any of the peasant holders who cannot, or who do not wish, to keep cattle. A Nyasaland native has been provided by the Medical Department to instruct in brick-burning, mason's and carpenter's work, together with a Tribal Dresser to attend to their medical comforts. Both the latter are also employed at the Prison camp.

(b) *The Demonstration holders.*—The three demonstrators have worked exceptionally hard, putting over 6 acres each under the hoe within $4\frac{1}{2}$ months after occupation. The land was free of trees, but only partially stumped and with a heavy cover of vegetation. They should each receive 200s. in cash by the time the rest of their cotton is sold. Their other cash crops have been groundnuts and cowpeas. They are now helping to erect their own sun-dried brick cattle sheds and kitchens.

MPANGANYA EXPERIMENT STATION, RUFIJI, PROGRESS REPORT FOR THE SEASON 1935-1936

BY

J. ROBERTSON.

CLIMATIC CONDITIONS.

The year 1936 witnessed the greatest floods experienced within living memory; considerable havoc was caused to native crops, in certain areas, the entire crops being damaged by flood water. The annual rise of the Rufiji river and the consequent flooding of riverine lands is now regarded as commonplace in the district, the amount of flooding and the area inundated varying of course with the amount of precipitation within the catchment area drained by the river. This year, owing to the exceptionally heavy rains inland, the rise of the river was earlier and much more rapid than in previous years and the maximum height subsequently attained by the river water was far in excess of anything previously recorded. The comparative heights of the river in 1929 (a dry year) and in 1936 will give some idea of the extent of the flooding:—

							1936.	1929.
January	Max.	...	...	...	...	...	11' 4"	1' 9"
February	"	...	...	...	...	...	11' 0"	2' 0"
March	"	...	...	...	...	...	13' 2"	2' 10"
April	"	...	...	...	...	...	13' 7"	9' 6"
May	"	...	...	...	...	...	12' 10"	4' 9"

(Zero is a point 15' below the level of the bank at Mpanganya).

Concurrent with these abnormal floods the amount of rainfall in the district was remarkably low. Consequently while crops in the low lying areas were ruined by flood water, those grown on higher land under rain conditions in many cases failed miserably, and the spectacle was witnessed of natives throughout the district uprooting rain-grown cotton a few months after planting since there was no hope of obtaining any crop from it.

With the subsidence of the flood water, in all land bordering on the river which was previously flooded land, natives planted large areas with maize and cotton; thanks to the fertility of the soil, enormous crops of maize are being harvested, while the estimate for the cotton crop is 2,000 bales, exactly double last year's figure, which in turn was larger than any figure previously recorded.

On the Mpanganya Agricultural Station, the rice crop was entirely ruined, the rice fields being under water for nearly three months. A considerable amount of flooding also took place on the higher ground near the Station buildings, a part normally devoted to the production

of rain-grown crops. In this part the river level was only a few inches below the level of the bank and it is estimated that a further rise in the river of six inches would have put the entire farm under water. As it was, the water table in the unflooded land was so high that many of the crops died off, while the suppression of weed growth in crops remaining became an extremely difficult task.

CROPS.

Rices.—Planting of rice commenced on the Station in early January and was completed in the beginning of February. The following were laid down:—

(a) An observation plot of 68 local varieties; (b) Four separate variety trials; (c) Several multiplication plots.

Cottons.—A time-of-planting trial with planting at fortnightly intervals from mid-December to the end of April was laid down. The trial was divided into two 5×5 Latin Squares. The results are set out below:—

<i>Treatment Means.</i>	
<i>Planting Date.</i>	<i>Latin Square No. 1</i>
A. Mid.-December = 445	lbs. seed-cotton per acre
B. End December = 367	„ „ „ „
C. Mid.-January = 272	„ „ „ „
D. End January = 197	„ „ „ „
E. Mid.-February = 60	„ „ „ „
<i>Latin Square No. 2</i>	
A. End February = 203	lbs. seed-cotton per acre
B. Mid.-March = 72	„ „ „ „
C. End March = 90	„ „ „ „
D. Mid.-April = 40	„ „ „ „
E. End April = 42	„ „ „ „

From these two experiments it would appear that the optimum planting time for cotton under the conditions experienced in 1935–36 was during the short rains. This result is easily explained by the very heavy rains in Nov.–Dec. 1935 and the failure of the long rains in March–April 1936. Consequently, the early planted cotton made good growth before the onset of the dry period, while the ripening of the plots was not marred by bad weather. Normally the reverse is the case—the short rains are quite light and by far the bulk of the precipitation occurs in March and April, so that very early planted cotton makes poor growth, opens during the main rains and consequently is of poor grade. It may be added that rain-grown cotton throughout the district is usually planted from the end of February to early May, while the flood cotton or “Mlau” is planted immediately after the floods recede and the land is in a fit state for planting.

Variety Trial.—U.4/4/2 has given the highest yield, although the figure is not significantly greater than that of Mp.9/2. This is not

an unexpected result since conditions were much too dry for U.4/4/2 to give of its best. Normally, in the Rufiji, the local cottons, as a result of high rainfall and fertile soil, produce too rank a vegetative growth at the expense of fruiting, while U.4/4/2, by reason of its inherent fine vegetative structure produces a very heavy crop. This year, however, the dry conditions inhibited excessive vegetative growth in the local cotton so that a relatively heavy crop was produced, while it was obvious that the poor growth made by U.4/4/2 did not allow it to carry a heavy crop. Mp. 9 is the only other Mp. selection of note; this and Mp. 12 are the only Mp. selections ever to be grown as a bulk crop on a large scale. Many of these Mp. selections still retain their individuality even although little work has been done on them for a number of years. Mp.4/2 is a short stature selection which does not appear to be suitable for local conditions. Mp.17 and Mp.9 are considered too tall and straggly and are damaged badly by high winds. Mp.9/2 is a short stature type carrying the heaviest crop and showing by far the best opening of any cotton ever grown here. The seed cotton was practically free from pink bollworm and as this pest was very common here this year the question of varietal resistance to it should not be lost sight of. Unfortunately the lint length of Mp.9/2 is not very good but it should be capable of improvement and several selections have been made this year with this end in view.

Cotton Selections.—One hundred and ten single plant selections have been made, chiefly re-selections from the progeny plots grown on the station this year with a few selections made from the district rain-grown cotton. The “Mlau” cotton is not yet ready and consequently no selections have been obtained from this type so far. The selections made show considerable promise, several giving a maximum lint length of $1\frac{1}{4}$ inches, the lint of these being strong and silky. It has been found both here and elsewhere that in American Upland cotton the best quality lint and the highest yields have been obtained from strains having heavily fuzzed seeds and it is suggested that work be concentrated on these only.

U.4/4/2 Cotton.—The bulk plot of U.4/4/2 proved an entire failure since the cotton was twice killed off by the flooding of the river, and on its being replanted in May, conditions were far too dry for the production of any crop.

Cultivation Trial.—A simple cultivation trial to test the possibility of planting cotton on ridges instead of on the flat, was laid down. Two treatments only were employed viz. :—Drill v. Flat, the lay-out adopted being the Half Drill Strip method. The following results were obtained :—

Average yield per acre on flat = 489 lbs. seed-cotton per acre
 Average yield per acre ridges = 562 " " " "

It will be noted that an increased yield was obtained from ridge planting, although the difference in yields is not significant. It may be added that natives usually plant on the flat here, clearing and burning the superficial weed growth prior to planting. By ridge planting, the weed growth can be returned to the soil very easily while the process of constructing the ridges involves a thorough cultivation which the soil does not get when cultivation on the flat is employed.

Rotation Experiment.—The initial plots of a rotational experiment were laid down during the year. The treatments were:—

- A. Cover crop (*Dolichos lablab*).
- B. Maize planted in main rains.
- C. Cotton " " " "
- D. Maize planted in short rains followed by cotton interplanted in ripening maize.
- E. Maize and groundnuts planted in short rains followed by cotton as D.
- F. Alternate rows of maize and cotton planted at same time in main rains.
- G. Similar to F. with the addition of groundnuts.

Part of the experiment was ruined by flood water in April while the crops planted after the subsidence of the flood were an utter failure, on account of the drought.

It is proposed to repeat the experiment on flood land next year. It might be stated that the usual custom among native cultivators here is to plant maize and rice (separately) in the short rains of November and December and to follow these with maize and cotton, on the same plots of land, after the early sown crops have been harvested. In some cases, in order to avoid delay in planting, cotton is interplanted between the rows of ripening rice. For some years now the natives have adopted a system of mixed cropping in which maize and cotton are planted in alternate rows; *i.e.*, on the rice land after the flood water has receded and the rice has been harvested. The system has been widely advocated this year both by this Department and by the Administration, and excellent crops of both maize and cotton are now being reaped. Had pure cropping been advised, the natives would have planted large areas of food crops at the expense of cotton. With this system of simultaneous planting, the maize can be reaped within a few months, leaving more space for the cotton to develop.

Sesamum.—Seed of white, yellow and black sesamum was received from the Lindi Province and planted on the station. Several typical plants within each colour group were harvested separately with a view to determining the inter-plant variation of oil content, and ultimately to select and breed a type with a higher oil content than the commercial samples at present grown in East Africa. The plants have just been threshed but no details regarding oil content are available yet.

COTTON PESTS IN TANGANYIKA, 1936.

BY

W. V. HARRIS.

The incidence of pests on cotton in Tanganyika during 1936 has been more or less as usual. The abnormal prolongation of the rains in the eastern cotton zone caused some increase in insect incidence as a result of either water-logging or of late planting. The opening-up of new areas has added to the known distribution of some of our pests. *Helopeltis* bug, a newcomer to the list of major pests, was again in evidence.

PINK BOLLWORM.

Platyedra gossypiella is still restricted to the eastern zone. There has been an increase in numbers in the Morogoro district, the population reaching 14 per hundred locules in October as against 4 in 1935. In the Rufiji district, pink bollworm is a pest of considerable importance, no doubt owing to the overlapping of the rain-grown and flood-grown crops.

Platyedra cunctatrix was not recovered from the observation plots at Kigoma this year. Kidney cotton has been eradicated as far as possible in that area. The bollworm *Argyroproctus leucotreta* was found there for the first time in cotton in the Territory.

AMERICAN BOLLWORM.

Heliothis obsoleta was the cause of severe boll shedding at Shinyanga early in the season. Favourable weather however enabled the plants to produce a good top crop. An intense infestation was found on a number of European farms in the Babati area, where moist cool conditions had induced abnormal vegetative growth. Native plots on the plains below were quite free.

STAINERS.

Dysdercus spp., were generally less numerous than usual. *D. fasciatus* failed to appear in numbers as the first bolls opened, with the result that later pickings were above the average in freedom from staining.

Callidea and Nezara bugs were few, except in the Tabora district, where Callidea was once more so injurious that the discontinuance of cotton-growing there is under discussion.

HELOPELTIS.

This bug was more injurious than before in the Morogoro, Handeni and Usambara areas. Its occurrence was particularly localised, and

in the first two areas named, was closely associated with the stem weevil *Apion xanthostylum*. An almost complete loss of crop was the usual result of *Helopeltis* attack.

JASSID.

Jassid was numerous in the Lake Victoria basin. During May and June, local varieties of cotton were severely attacked at Shinyanga. It is not a pest in the eastern zone.

TERMITES.

Microtermes was the cause of considerable damage at Shinyanga during hot dry weather in February, by boring in the roots and stems. Some injury by the harvesting termite *Hodotermes* was also reported. In the Moshi area, a species of *Hamitermes* was found cutting through the stems at ground level in the manner of a longicorn beetle.

VERMIN.

There was a slight outbreak of the grey field mouse, *Mastomys coucha*, in Kilosa. Poison baits were distributed in good time and serious damage was averted.

LABORATORY AND FIELD WORK.

Population statistics of cotton pests in general were obtained from plant examinations and boll counts throughout the season. Observations on the genus *Dysdercus*, of which seven species are now known to feed on cotton in Tanganyika, were continued. *Helopeltis* was studied, though mainly with a view to its control in nurseries and in tea plantations.

NYASALAND

COTTON EXPERIMENT STATION, DOMIRA BAY, PROGRESS REPORT FOR THE SEASON 1935-36.

BY

H. C. DUCKER, W. L. MILLER AND S. T. HOYLE.

SEASON.

The rainfall total for the season was 34.46 inches, 5.79 inches more than in 1934/35, and, with the exception of 1931/32, the highest recorded on the Station. In that year, however, though 36.10 inches fell, the distribution was good throughout the season and high yields were obtained. This past season, good rains had fallen by December 12th and most of the planting was completed by December 20th. Two weeks hot rainless weather followed which necessitated some supplying, but in general little harm was done to the crops. Light rains carried on at reasonable intervals through January to mid-February, but from then on conditions became bad, particularly from a cotton point of view.

From February 15th to 29th 11.21 inches of rain were recorded, followed by 10 inches to March 25th, during which period there was but little sun and much water-logging occurred. From March 25th less than 0.5 inches fell during the remainder of the season.

This was an almost complete reversal of the conditions of 1934/35, when no effective rain fell between February 9th and March 16th after a period of excessive moisture supply, and the results from a cotton point of view were even more disastrous.

COTTON.

At the beginning of the 1934/35 cotton report emphasis was laid on the seasonal rainfall distribution. Even greater emphasis can be laid on that of this season which has resulted in the lowest yield per acre from the bulk crop yet recorded, approximately 140 lbs. lint per acre against a normal crop of 250 lbs. lint.

Against this, however, may be set the fact that in both 1934/35 and 1935/36 certain quick maturing strains have given good yields, particularly certain of the Gatooma strains and some early selections made at Domira Bay. With two so markedly contrasted seasons one

may feel some confidence in strains which have done well in both. In the breeding block re-selection work within the U.4 lots has been continued, and most encouraging results were obtained with re-selections from Z.14, a strain selected at Barberton in 1928 which has now been re-selected at Domira Bay since 1931. This strain led in the strain trial in 1933/34 and this year has again shown itself a significantly higher yielder than its fellows. It is somewhat similar in habit to certain of the successful Gatooma strains. C.28 which has been a consistently good performer did not this year show to such advantage as in previous seasons, but in the strain trials its yield was as good as or better than, all except Z.14.

Four new strains from Barberton did well in observation plots, and will be included, with the best of the Gatooma strains, in the trials next season.

The cross-bred material has been carried on for another generation and, as with the U.4 lots, the earliest strains showed to greatest advantage this season. This was particularly so with the crosses containing Gambia Native and with certain of the $(U.4 \times \text{Cambodia}) \times U.4$, while $(\text{Meade} \times U.4) \times U.4$ N.10 gave some high yields and good staple.

Certain lots containing no U.4 in their parentage also did well, particularly Over the Top $\times$ Harland's big boll (jassid-resistant re-selection), which provided a striking plot; Over the Top $\times$ S.G.29 also yielded well.

Cotton Experiments.—A manurial trial, laid down for the first time at Domira Bay, gave no significant results other than an increase shown where cotton bushes were burned *in situ* on one series of plots. This is of local interest in that up-rooting and burning regulations, enforced in Nyasaland, may be of value to the cotton crop apart from their effect in pest control. Soil fertility as such does not appear so far to be a limiting factor at Domira Bay.

A spacing experiment again failed to give results showing any significant differences, but it is of interest to note that a spacing of $3' \times 2'$ leaving three plants per hole at thinning, has for the third time given the highest yield. A similar result has been obtained at the Port Herald District Station.

A topping and thinning experiment was suggested by a number of enquiries received from various parts of the country. This failed to show any significant differences between the treatments given; three times of thinning and three times of topping were tested. Time of thinning does not appear to be of any importance up to the time the

plants have 8-10 leaves, while topping made no difference to the final crop. It was observed that the topped plots seemed to "show" more cotton than the untopped plots.

A cultivation experiment was introduced for the first time and produced some striking results. Ordinary weeding without inter-cultivation, ordinary weeding with thorough inter-cultivation, and the normal native practice of minimum weeding without inter-cultivation were compared. In the case of the last named, advice was given by an ordinary native cultivator as to when weeding should be done, and faithfully followed. Even though the cotton in the native practice plots appeared to make good recovery after being nearly smothered in weeds, a common experience for young cotton in native gardens, it gave a yield significantly lower than that of either of the other treatments. There was no significant difference between the other treatments, and deep hoeing between cotton appears to be a waste of time and money.

If the results of this experiment are confirmed it would appear that propaganda for early weeding alone might result in a 30 to 40% increase in the native crop.

The three strain trials using 6×6 Latin squares that were laid out showed that the re-selected Z.14 was significantly higher yielding than the standard station cotton C.28.

A Uniformity trial, using Z.14 was carried out. 490 rows, forming in all a rectangular block of just under one acre, each row being 7 yards long, were harvested and weighed separately and the results sent to Rothamsted. The thanks of the Corporation are due to the Statistical Department at Rothamsted for their examination and report on these results. It seems that the standard plot used on the Station appears to be as good as any. This is 16 yards square, of which 14 yards square is used at harvest.

PESTS.

Locusts.—The first swarm of Red Wing locusts for the season was not seen until January 22nd. Large numbers settled in one corner of the Station, but did no damage and passed on the following day. A second swarm arrived on February 7th and stayed on the Station, settling mainly in the then half grown maize. Egg-laying started almost immediately and by early March hoppers were numerous in patches. Some maize was nearly completely defoliated, but cobs were well formed by the time this occurred and the loss was small. Very slight damage was done to cotton. Adult locusts were in evidence till June and are still (November) to be found in the fields under standover

pigeon pea. It appears that they are now in the "Dissocians" phase and that Domira Bay may have seen the worst of the locust invasion.

Cotton pests.—Records of Stainers and bollworms were kept as in the 1934/35 season, and the progress of the pest cycle followed. This work is now being done in close co-operation with the Insect Pest Control Section at Barberton.

At the Station the activities of the pests this season were definitely secondary to the effects of the season on the cotton crop, and the fact that what crop was made was early for the most part resulted in a much lower percentage being stained than was the case in 1935.

ROTATION CROPS.

On the whole, the various rotation crops, with the exception of certain beans, did much better than in 1934/35.

The average yield of mass selected Potchefstroom Pearl maize from 20 acres was over 3,000 lbs. per acre.

The performance of the selections from native maize, of which 35 were retained from last year, was noteworthy. A five acre field gave 900 lbs. more per acre than did the Potchefstroom Pearl bulk, a somewhat surprising result since yield per acre was not primarily considered in making these selections, but weevil and grain moth resistance. A variety trial will be arranged next season; twenty re-selections have been retained.

Groundnuts did well, the average yield on $7\frac{1}{2}$ acres being 1,300 lbs. per acre.

A combined spacing and variety trial showed that Barberton bunch was a significantly higher yielder than the Station Virginia bunch, but not significantly better than either of the other varieties tested, Gambia and Nyasaland Native. The difference shown between the two spacing arrangements tried were not significant.

Tepary, Bush Lima, and haricot beans were all failures, but nine varieties of Soya procured through Barberton showed much promise. Root nodules were found on one of these varieties, "Ami" from Bremersdorp, though no inoculation had been done. This variety made the best growth and cover, but shattered rather badly at harvest.

Sorghum and bulrush millet plots did well, a variety of bulrush millet from Port Herald being the best of its type.

One field was given up to inter-cropping cotton with various rotation crops. The latter almost without exception did well, but the cotton was a failure. It would not appear that cotton grown as at Domira Bay as a summer crop, can be satisfactorily used in crop mixtures. The problem will be rather to find the best ways of arranging

it in rotation with other crops, and for this purpose a large scale rotation experiment is being planned. This should provide information regarding the present standard rotation in use on the Station and indicate how it may be improved.

CATTLE.

Except in one or two favoured places, there are no cattle in the S.W. Lake shore areas owing to Tsetse Fly. An experiment has been commenced to test the practicability of keeping cattle, subject to intermittent infections of trypanosomiasis, in reasonable condition by suitable treatment. This if successful may lead to an extension of cattle keeping, and later perhaps to fly clearance schemes being justified.

Ten native bullocks have been purchased, and brought down to the Station. Blood slides are being taken weekly for examination by the Veterinary Department, which is co-operating in the scheme, and the cattle showing infection as well as marked clinical symptoms are treated by injection with Antimosan (Bayer) or antimony tartrate. So far the degree of infection has been low, and there are indications that the native cattle that are being used in this experiment have a marked degree of tolerance to trypanosomes.

One bullock has died from an unknown cause, not corresponding in its symptoms to trypanosomiasis, and not discoverable by *post mortem* examination. The others are in good condition and already at work, ploughing and ridging.

A considerable area of bush has been cleared on the west side of the Station, and the station clearing has been linked up with that on the nearby Chitala Estate. By this means it is hoped to keep back "fly" and lower the incidence of infection for the cattle.

Much assistance has been given by Mr. B. D. Burt of the Tsetse Survey, Tanganyika, who has paid an extended visit to the Lake Shore areas, by Mr. J. De Meza the Chief Veterinary Officer, and by the District Veterinary Officer, Mr. S. G. Wilson.

A commencement has been made with compost making on the lines previously used at Makwapala and reported on some years since.

BUILDINGS.

A third house on the Station was completed, and occupied by the Cotton Specialist, during the year. Eight more double brick huts have been added to the labour lines, which are now fairly complete; the type of brick hut erected is in favour with the native labour. A brick cattle yard of the covered type has been built; it is provided

with an open outer yard and crush pen. In addition a small isolation hospital for cattle has been built on the advice of the Veterinary Department.

The plinth of the main storage tank at the borehole has been raised to improve the head of water, and the pipeline extended to the power house and to a cattle trough, which has been built near the latter building.

At Lilongwe a combined store and office, a most serviceable building, has been built on the Corporation's behalf by the officer in charge of the Likuni Experimental Station. This is conveniently sited in relation to the other buildings and to the cotton section of the Station.

LILONGWE.

Excellent results were obtained with cotton at this Station, where the rainfall was somewhat better distributed than at Domira Bay. The difference was not such, however, as to explain entirely the results, which were undoubtedly due to the fact that only very quick maturing strains were planted at this Station. Stands were very patchy owing to a rough tilth and very low seed rate, and hardly exceeded 40%, but in spite of this, over two tons of clean seed cotton were harvested from the ten acres sown. A large number of single plant selections were made.

There was little to choose between the best of the Gatooma strains and the best of the Lilongwe crossbred lots.

A number of outside plots were grown, planted on various European Estates. Of these, three which were planted at the same time as the Experiment Station gave comparable results, but others, which from one reason or another were later, were failures.

Lilongwe undoubtedly provides the most extreme "summer crop" conditions under which cotton is likely to be grown commercially in Nyasaland; any delay to the flowering and bolling, from whatever cause, is fatal to the crop.

THE COTTON INDUSTRY IN NYASALAND.

The cotton crop in Nyasaland this past season has failed to come up to early expectations. It is not completed at the time of writing, but it does not appear that the yield will be more than 10,000 bales as against the 27,000 bales expected when seed issues were made.

The season has had most to do with this failure, assisted by other factors. The Lower River areas for example, after two good years at the end of a dryish cycle of seasons, appear to be definitely back again in a wetter cycle of seasons. Under these changed conditions,

early planting propaganda, which in the dry cycle had certainly given results of value, proved disastrous in that it had resulted in the practical elimination of a close season sufficient to control Red Bollworm (*Diparopsis castanea*).

The effects of this have shown up immediately on the return of wetter conditions, and planting practices will again have to be modified to meet this threat. A close season of six weeks has been arranged for this year, to be extended if possible to eight weeks in 1937/38.

Unfortunately the up-country areas were unable to redress the balance, since in addition to the greater part of their area receiving a rainfall distribution comparable with that of Domira Bay, there was the complication of partial famine in many districts.

This made the natives anxious about their food crops, which rightly received prior attention, but with the dry spell which occurred after December 20th, it resulted in little cotton being planted before January with, as might be expected, poor results. Experiments at Domira Bay and elsewhere have shown clearly that summer crop areas must be planted in December.

Fortunately prices to the native grower have been good, and he is not easily upset by adversity. This year food supplies are excellent and there is every indication that an increased cotton seed distribution will take place. It is to be hoped that the rains will be favourable.

SEASONAL RAINFALL.—DOMIRA BAY EXPERIMENT STATION. 1935/36.
IN INCHES.

	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>June</i>
1	...	...	...	...	...	...	...	...	...
2	...	...	...	...	0.04	0.29	0.13	...	...
3	...	...	...	...	0.07	...	0.10	...	...
4	...	...	...	...	0.40	0.02	...	...	...
5	...	...	...	1.73	...	0.68	...	...	...
6	...	...	0.04	0.01	0.04	0.33	...	...	...
7	...	...	...	...	0.01	0.39	...	...	...
8	...	...	0.26	1.48	...	0.30	...	...	...
9	...	...	...	...	0.07	1.85	...	...	...
10	...	...	0.18	...	0.07	0.01	...	...	...
11	...	...	...	0.52	...	...	...	...	...
12	...	...	0.55	...	0.16	0.88	...	...	...
13	...	...	0.23	0.03	0.04	0.25	...	...	...
14	...	...	0.47	0.12	0.06	0.03	...	...	...
15	...	...	1.25	0.48	1.07	1.18	...	...	...
16	...	...	0.92	0.02	0.60	0.87	...	...	...
17	...	...	...	0.46	1.06	0.05	...	...	...
18	...	0.38	...	0.08	0.48	0.55	...	...	...
19	...	0.01	...	...	0.78	0.37	...	...	...
20	...	...	0.12	...	0.58	0.66	...	...	...
21	...	...	0.56	0.08	1.68	0.23	0.10	...	...
22	...	...	...	...	0.44	0.03	0.10	...	...
23	...	...	...	...	1.26	0.55	0.03	...	...
24	...	0.01	...	...	0.38	0.10	...	...	...
25	...	...	...	0.01	0.86	0.39	...	...	...
26	...	...	...	...	0.38	...	...	...	...
27	...	1.10	...	...	...	...	...	...	...
28	...	...	...	...	0.05	...	...	...	...
29	...	...	...	0.14	1.59	...	...	...	...
30	...	...	...	...	...	...	...	...	...
31	...	...	...	0.58	...	...	...	...	...
Total ...	—	1.50	4.58	5.74	12.17	10.01	0.46	—	—

The continuously wet and dull spell in February/March is well shown by this table. It makes an interesting contrast with the conditions shown by the 1934/35 table.

NIGERIA.

PROGRESS REPORT FROM THE CORPORATION'S SEED FARM, DAUDAWA, 1935-36.

BY

G. BROWNE AND A. E. CASEMENT.

This report covers the period from November 1st, 1935 to the 31st October, 1936.

CROPS.

Cotton.—When last year's Report was written the cotton season was more than half way through. The strain of cotton then being grown was K.1., a strain which had done well in the Northern areas around Kano where the soil is of a much sandier nature than it is at Daudawa. On the Main Farm 660 acres were planted in this strain and approximately 170 on the farms of natives settled on the land with the help of the Corporation. Germination had been good and an even stand of cotton obtained, but at the time of writing a certain amount of insect damage was evident. Later a good deal of bollworm damage was also seen. The harmattan season commenced suddenly and severely thus ripening the crop very rapidly, especially on the drier soils. Picking commenced on December 20th, and while the quality and cleanliness were excellent, it was soon obvious that yields were going to be below normal. Three pickings were taken, the work finishing in early March.

From the Main Farm 97,515 lbs. of No. 1 seed cotton were obtained and also 1,075 lbs. of No. 2 grade. The average yield, including No. 2, was 149 lbs. seed cotton per acre as against 258 lbs. per acre last year. The highest yield of any individual field on the Main Farm was 295 lbs. per acre, as compared with 444 lbs. from the same field last year. On the Co-operative Farms where it was estimated that 156 acres were in cotton, 26,121 lbs. of No. 1 grade seed cotton was produced, the average being 159 lbs. per acre and the highest individual yield 266 lbs. The two Mixed Farmers' farms comprising 14 acres yielded 1,979 lbs. of seed cotton, an average of 141 lbs. per acre. From these comparative figures it will be seen that the drop in yields was general on all sections of the farm, the principal reasons being the lack of October rains and the early harmattan.

Of the 660 acres in cotton on the Main Farm, 100 acres were sown through bullrush millet, 40 acres were inter-planted with guinea-corn, widely spaced for ensilage, and a further 40 acres guinea-corn, again widely spaced—20 ft.—which was sown as an experiment in order to see whether a part-corn crop could be grown with cotton. Where the cotton was sown through the growing millet, the yield was 93 lbs. per acre; where it was sown immediately after the millet crop had been harvested, the yield was 99 lbs. per acre. The cotton interplanted with guinea-corn for ensilage yielded 92 lbs. per acre and that with the widely spaced guinea-corn as a food crop, 184 lbs. per acre. The average yield over the remainder of the farm under cotton was 159 lbs. per acre.

With regard to the permanent experiment referred to in last year's report in which the current strain of cotton under multiplication was sown in alternate blocks with ordinary B.C.G.A. cotton as a means of yield comparison, the result showed K.1. as yielding 305 lbs. as against B.C.G.A. Ordinary 253 lbs. per acre. Another experiment mentioned in the last report was that of "deep" ploughing versus "super" cultivation, and both compared with ordinary cultivation. The "deep" cultivation showed a yield of 199 lbs., the "super" 179 lbs. and the ordinary cultivation 155 lbs. (By "deep" cultivation is meant ploughing to a depth of about 10 inches, "super" means ordinary ploughing, extra weeding and top cultivation, whereas "ordinary" is the cultivation as normally carried out over the farm. As a result of this experiment, the "super" form of cultivation has been carried out over the whole cotton area this year, the "deep" ploughing being a necessarily slow process). An experiment in order to discover whether the yield of a cotton crop following tobacco sown the previous year was affected by the latter crop came to nothing, as, owing to a misunderstanding, no definite comparative figures were kept, but it is known that the cotton yields from the whole field of 20 acres, 11 of which were under tobacco the year before, was more than 25% higher than the farm average.

The price paid to the Co-operative and Mixed Farmers throughout the season ranged from 1.10d. to 1.30d. per lb. according to Funtua Market prices at the time of sale.

It was decided that the whole operation of ginning, baling and pressing should, for the first time, be done at Daudawa. With the exception of trouble with the press, all went well and in due course the half-pressed bales were dispatched to England for sale. 125,577 lbs. of No. 1 seed-cotton were ginned altogether from the Main Farm and the settlers' farms and this produced 37,128 lbs. of lint and 88,618 lbs. of seed, a ginning percentage of 29.59. Hand pickings,

obtained in cleaning the No. 1 grade amounted to 1,092 lbs. from the Main Farm and 38 lbs. from the settlers' farms. These two lots making 1,130 lbs. in all, ginned 378 lbs. of lint equal to 33.45%.

Of the total seed produced 86,717 lbs. were available for distribution, the balance of 1,901 lbs. being from the permanent experiment and therefore not suitable. Of the former amount 6,200 lbs. were kept for sowing in the present season and the remainder, 80,517 lbs. was railed to Kano for distribution purposes in that province.

In all, 233 half-pressed bales of No. 1 grade lint were sent home, two of these being B.C.G.A. Ordinary for comparative purposes, and the remainder all being K.1. The brokers reported as follows on the K.1. "Strict Good Middling. Creamy in colour. Staple about 1", neppy and rather soft." Value 6.55d. to 6.65d. Regarding the two bales of B.C.G.A. Ordinary produced from the permanent experiment, the report was "Strict Good Middling. Creamy in colour. Staple about $1\frac{1}{16}$ ", neppy and rather soft" value 6.75d. The valuations were based on July American Futures at 6.15d. On actual sale the K.1 lint sold for 7.06d. and the B.C.G.A. at 7.16d., cotton prices having risen in the meantime.

In order to spread out the planting and harvesting periods, and also to attempt to compromise in the event of either a surfeit of rain or a shortage, it was decided to start sowing about the middle of June for the 1936/37 crop, but, owing to unsuitable conditions it was not possible to begin until the 20th, this date being some 10 days earlier than last season. The scheme has been successful, inasmuch as, had sowing not been started, it is highly probable that, as a result of the difficult conditions during July, it would not have been possible to finish the scheduled area, *i.e.*, 580 acres. This year three different strains are being multiplied, the principal one being D.31. The separate strains and the areas occupied by them are as follows:—
D.31 ... 320 acres on Main Farm, and approximately 40 acres on settlers' farms.

E.31	...	10	„	„	„	•	
K.1	...	250	„	„	„		and approx. 155 acres on settlers' farms.

In addition to the above, the permanent trial of the current strain—in this case D.31—is being tested against Ordinary B.C.G.A. on a 10-acre plot. As has been already mentioned, conditions during July being very difficult, planting actually did not end until the 8th of August. For the same reason germination was poor and heavy supplies were necessary, some fields having to be supplied four and five times. Even

then the stand of cotton was far from perfect. An extraordinarily good August improved matters tremendously, but an almost record rainfall in September slowed up growth again. Nearly an inch of rain fell in October, the harmattan held off wonderfully well, and heavy night dews fell, all of which proved highly beneficial for the later sown cotton. A good deal of leaf curl became evident in the earlier sown fields, however, as well as some damage by aphis and boll-worm, but fortunately these fields are few. No stainers had been seen by the date of writing (November), and the bulk of the cotton looks healthy and well, though a trifle on the small side owing to a wet July and consequent late planting dates. If all goes well it is hoped that about normal yields will be obtained. A considerable proportion is really late sown owing to the heavy supplies which were necessary, but on the other hand, the cotton has seldom come along so fast as has this year's crop during the past month.

A feature of the present season has been intensive and continued cultivation of the cotton crop and it is thought that probably the relatively good crop to be seen now is, to a large extent, due to this intensive cultivation. This has all been done by cattle-drawn implements either imported or of our own manufacture. Ridging up was done by P.I.K. ploughs, followed, after a further cultivation, by the new "Emcot" ploughs for the final ridging. First flowers were observed about mid-August and flowering during October has been heavy.

Bullrush Millet.—The millet crop, which occupied 100 acres, again was planted on and from the 18th April. The crop, as was the case with most of the millet crops in this locality, did not do particularly well, but average yields ought to be obtained. The heads, tied in bundles, have been stacked adjacent to the fields which produced them to await the harvesting of the guinea-corn crop, after which thrashing will be done on the spot by the Garvie thrasher purchased last year, the waste products being made into compost there and later returned to the land. Yields are therefore not available yet. In order to give more attention to the cotton crop in future years, it is proposed to reduce the area under millet and groundnuts next year.

Guinea-corn.—The total weight of guinea-corn produced last season (not recorded in the last Annual Report) was 98,150 lbs. an average of 426 lbs. per acre. The 70 acres grown as a straight crop yielded 46,755 lbs. an average of 668 lbs. per acre; the 100 acres through groundnuts produced 43,908 lbs. or 439 lbs. per acre and the 60 acres planted at 20' intervals through cotton 7,487 lbs. or 125 lbs. per acre.

During the present season 220 acres have been sown as follows :— guinea-corn, close space (2 feet), 60 acres; guinea-corn and millet, 40 acres; guinea-corn, millet and groundnuts, 60 acres; and guinea-corn and groundnuts together, 60 acres. Guinea-corn has done very well indeed this year and good crops ought to be harvested. Some of the fields of corn near to the silo pits are being partially de-leaved, the leaves being mixed with grass for ensilage.

Groundnuts.—Last year's yields from the 91 acres under this crop totalled 43,261 lbs. of unshelled nuts, an average of 475 lbs. per acre. Of these, 3,142 lbs. were kept for seed for use in the present season, while the remainder, after being shelled, produced 22,551 lbs. of nuts which were sold in Funtua @ £7 15s. per ton.

This season 120 acres of groundnuts have been planted, in all cases through guinea-corn and/or millet. From the fields lifted to date, it is thought that yields will not be above normal.

Tobacco.—The tobacco crop last year turned out to be practically a complete failure and, for several reasons, the principal of which is that the crop clashes badly with cotton in both sowing and harvesting, it has been decided to discontinue it.

Haygrass, etc.—The cutting of haygrass is now almost finished in the first 20-acre field. At the last moment one portion of the second field mentioned in the last report as having been cultivated and laid down, was utilised to grow some English varieties of potatoes, and a late crop of cotton was sown in another, the balance being left in grass.

CATTLE.

The herd consisted of 187 animals when the last report was written and now, after supplying 16 head to settlers, the number is 191, made up as follows :—129 working bullocks, 28 cows and heifers, 34 young stock, including calves. The deaths for the season total 37; these include 15 from trypanosomiasis, 5 from sclerosis of the liver, 5 from pleuro pneumonia, 4 from reaction to injections or collapse following it, and 2 from tuberculosis. The deaths this year may seem very heavy, but no fewer than 9 deaths occurred in one month (October) from an outbreak of pleuro pneumonia or the effect of injections to counteract it, so it will be seen that things might have been worse over the whole year. Deaths from tsetse fly infection appear high, but the majority of these occurred amongst newly purchased cattle; further, it is not absolutely certain that all the 15 animals actually died from trypanosomiasis, for the diagnosis is based on the general symptoms only. An outbreak of rinderpest was dealt with without loss, but,

in order to make certain, all the herd is to be double inoculated again.

Cattle are very difficult indeed to buy and prices have risen considerably. Farmyard manure is being used increasingly over the farm at the rate of 2 tons to the acre, about 200 acres being treated during the year.

LABOUR.

Male labour supplies have not been too plentiful again, owing to the increasing prosperity of the country as a whole. Work has never been held up, however, for plenty of women and children are available to fill in the gap in those periods when hand labour is mostly required, while cattle do the bulk of the hard work. Task work is very popular and almost invariably used.

SETTLERS' FARMS.

Four more mixed farmers have been added to the two who commenced operations last year on the Main Farm and four of the original co-operative farmers have been converted to mixed farming upon their own farms, thus making 10 mixed farmers in all. All have settled down to their work in a steady and confident manner, and there is little doubt that there will be plenty of applicants for farms next year. The converted co-operative farmers, having already had their farms given to them under the original co-operative scheme, have only to repay the cash advances made to them to enable them to provide themselves with cattle and implements. It is expected that expansion among the remaining co-operative farmers will be rapid, probably more rapid than can be dealt with owing to the prevailing shortage of suitable cattle. Crops generally, have been good and food crops excellent while no cattle losses have been experienced by any of them. The particulars of their cotton production are given earlier in this report. The two first farmers repaid roughly 25% of their total advances in the first year and ought to pay more from now on, providing the times continue to be good. The settlers between them have an estimated total of 195 acres under cotton this season.

WATER-WORKS.

A well was sunk in the more elevated part of the Co-operative Farms as the gravitated supply of water from the water tower was poor at this point. The old water tank and supply pipe were removed, being no longer necessary. Another well was sunk near Field 30. Both were successful and are lined with concrete.

BUILDINGS.

The cattle pens referred to in last year's report have been finished. Since the rains an extension has been added and some small improvements, such as water and food troughs suitable for the number of cattle accommodated. These alterations will be incorporated in the next pens to be built which ought to prove ideal for their purpose. A fence made of cast concrete posts and wire has been made taking in 5 acres of Field 5 on which stands the Stores, Ginnery and Main Farm buildings. The enclosure will form a nice paddock for sick cattle or calves. Two improved type of grain stores of our own design have been built and are very satisfactory. They contain a reinforcement of barbed wire embedded into the mud walls.

LOCUSTS.

Swarms of these insects made their appearance in November last and also in May and September of this year, but in no case was any damage done to crops.

METEOROLOGICAL DATA.

Another February storm occurred this year on the 28th, but little rain fell and no damage was done. Rain fell again in March, but the planting rains proper did not commence until April 17th, while the last rain fell on October 16th. July and September were particularly wet months this year, August and October being exactly the reverse. The year has been very difficult indeed from an agricultural point of view.

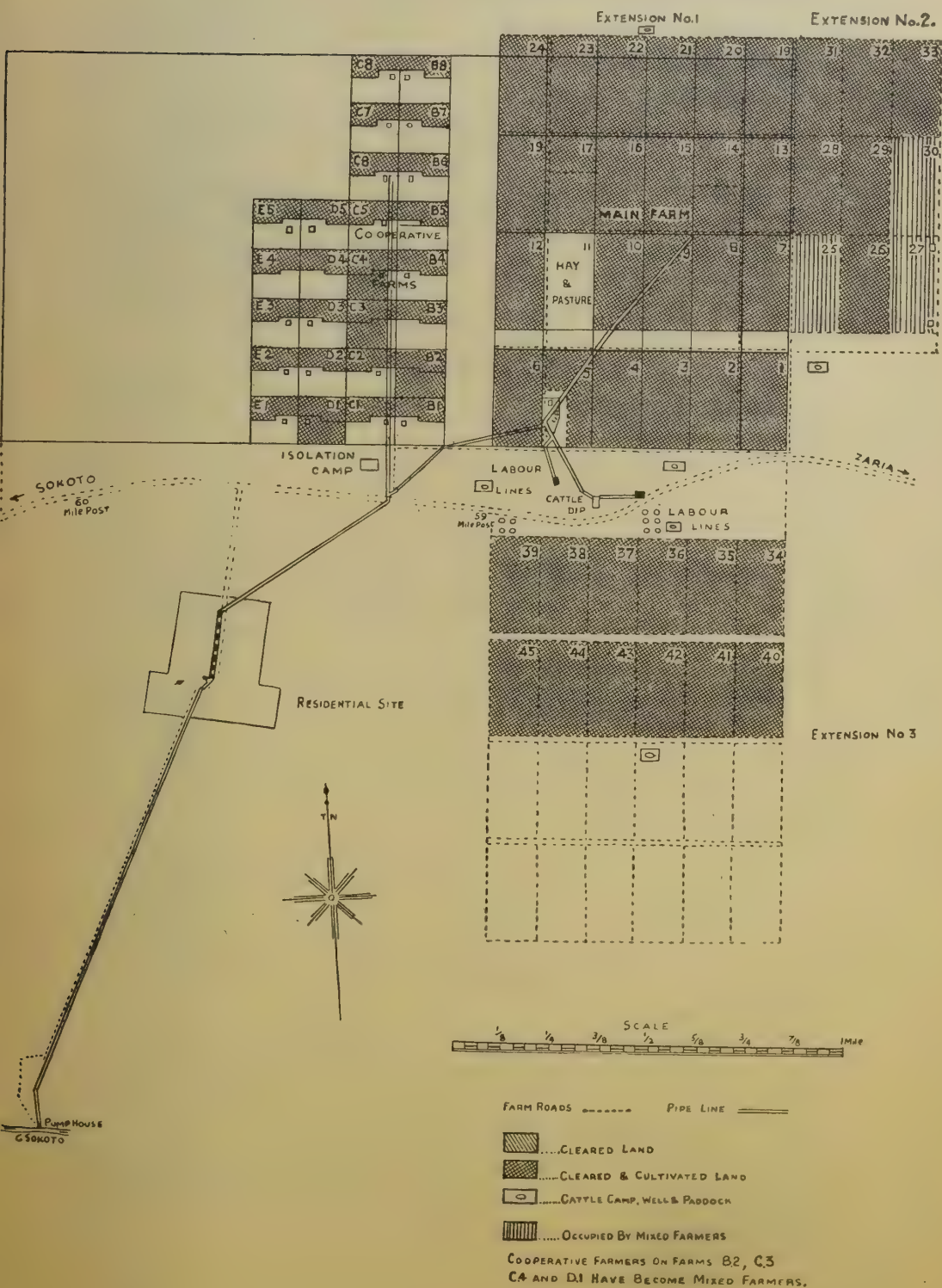
GENERAL.

Once more this opportunity is taken of extending the thanks of the Corporation and the Staff at Daudawa to those Officers of the Administrative, Agricultural and Veterinary Departments for their constant assistance and co-operation.

NIGERIA. FARM 1935-36 DAUDAWA SEED



DAUDAWA SEED-FARM, NORTHERN NIGERIA, 1936.



[Included by courtesy of the Nigerian Government.]

NIGERIA.

PROGRESS REPORT ON WORK ON COTTON IN THE NORTHERN PROVINCES FOR THE SEASON, 1935-36.

BY

J. K. MAYO.

ZARIA.

The weather during this season was unfavourable to cotton owing to excessive rain in August (14 inches in 27 rainy days) and practically none in October. The distribution and total fall is almost the same as that shown in the Daudawa report.

The main concern in the year under review was the yield and quality of the strain D-31, which had given high yields in 1933 and 1934, but whose quality was somewhat inferior to the ordinary commercial cotton derived from "Allen" and hereinafter referred to as "Standard."

Several other varieties were tested, including some twenty of Dr. Harland's hybrids, and eight U.4 types were grown under observation. This report however will confine itself to D-31 and two other strains, viz. : E-31.—A strain derived from Standard, immune to leaf-curl and jassid. SG.27.—A strain introduced from Uganda in 1931 and superior to others in quality.

The following is a summary of the performance of these strains compared with Standard in 1935-36 from sowing to finished yarn.

The growing conditions were normal as far as soil and cultivation were concerned and the yield a little above average. Every other plot was Standard and there were 6 plots of each variety. A poor crop of millet (280 lbs. grain per acre) was taken off 7 weeks after the cotton was planted.

	*Control.	D-31	E-31	S.G.27
Actual Stand per plot ...	1,090	1,208	1,156	1,094
Percentage of possible Stand...	73	81	77	73
No. of Plants which had leaf curl per plot ...	35	5	none	46
Percentage leaf curl ...	3.2	0.4	—	4.2
Previous season's percentage leaf curl ...	14.2	1.8	no comparable figures.	
Yield of seed cotton lb. per acre	284	365	312	268
Yield of lint lbs. per acre ...	83	117	102	82
Lint as per cent. of Standard	100	141	123	99
Broker's Valuation ...	6.83d.	6.63d.	6.78d.	7.28d.
Broker's Staple ...	1½" to Good 1½"	1" mixed with short	1½"	Full 1½"
Hairweight per cm. (10* mg.)	148	177	182	153
Per cent. normally thickened	35	50	51	24
Per cent. dead hairs ...	23	15	14	26
Lea strength at 40's Ring spin-	55.3	45.4	52.3	56.9
nings ...	52-54	30-32	46-48	58-60
Highest standard count ...	Very neppy	Fair	Very neppy	Poor
Yarn appearance ...	—	High yield: disease resistance: less immaturity: yarn appearance	High yield: disease resistance: less immaturity	Yarn strength: High standard count
Good qualities compared with Standard ...	—	Yarn strength: Low standard count.	Yarn appearance: high % waste in processing.	Susceptible to Leaf Curl. More immaturity.
Bad qualities compared with Standard ...	—	Yarn strength: Low standard count.	Yarn appearance: high % waste in processing.	Susceptible to Leaf Curl. More immaturity.

* Control. Standard seed obtained from Zaria ginnery in 1935.

These rather full details are given to show how each strain has some advantages and some disadvantages. The increased yields of lint per acre of D-31 over Standard were 39%, 40%, and 41% in 1933, 1934 and 1935 at Zaria. This is a very desirable advantage since it would bring direct and certain gain to the cultivator and so to the country at large. He could not be deprived of this advantage by middlemen or trading firms as might be done if the improvement were one of quality only. Unfortunately there is no doubt that this strain produces inferior yarn to Standard and it is difficult to arrive at a money figure for this inferiority, for the Broker's valuation is, for this variety, not seriously lower than Standard. The inferiority is in the strength of the yarn.

The following figures illustrate this:—

	Standard	D-31	Remarks
Lea Test	(1933 ... 44 lbs.	40 lbs.	Ring spinnings at 50's.
	(1934 ... 38 "	31 "	
	(1935 ... 40 "	33 "	
Broker's Valuation	(1933 ... 7.01 pence	6.66 pence	The 1933 trial was at Samaru but the 1934 and 1935 trials were on adjacent plots at Bomo.
	(1934 ... 6.69 "	6.74 "	
	(1935 ... 6.83 "	6.63 "	
Highest Standard count.	(1933 ... 60-62	48-50	
	(1934 ... 45-47	28-30	
	(1935 ... 52-54	30-32	

At 32's Ring spinnings D-31 gave a Lea strength of 61 lbs.

E-31 has given increased yields of lint per acre of 21%, 14% and 23% in 1933, 1934 and 1935 respectively, but has this peculiarity that in a large proportion of the locks the seed nearest the tip of the boll is dead and carries dead lint. In 1933 this strain was almost discarded on this account and no sample was sent for spinning test. In the 1934 trial the dead tips were removed at picking time and the resulting lint was classed equal or a little better than Standard. In 1935 the dead tips were not removed and have undoubtedly been responsible for higher Blow-room and Card wastes as follows :—

	Standard	E-31
Blow room	0.3 %	1.0 %
Card	8.5 %	10.1 %

Moreover the card web of E-31 was noticeably neppy. The quality of yarn produced was, however, markedly superior to D-31 and almost as good as Standard.

SG.27 have given equal yields of lint to Standard in 1932 and 1935 and the lint is superior, as shown by the broker's valuation, the high lea strength, and the high standard count. This is expressed by the brokers as an increased value of 0.45d. per lb. Such a premium, if maintained, would warrant an increase of price paid to the farmer in Northern Nigeria of $\frac{1}{10}$ d. per lb. of seed-cotton. But there is a risk of loss of yield due to Leaf Curl. The small increased Leaf Curl damage noticed in small trials is very liable to become a serious trouble when the strain comes to be grown on an extensive scale. This happened to two former strains, both of which were successful in small trials, but when grown on a larger scale at the Empire Cotton Growing Corporation farm at Daudawa one of them succumbed to jassids and the other to Leaf Curl and jassids.

Trials of these strains are still being conducted including many derivatives of D-31. No new varieties were introduced in the year under review.

GENERAL SUMMARY OF COTTON WORK IN THE NORTHERN PROVINCES, 1935-36.

After selecting for several years in the commercial crop (derived from "Allen") for quality without much success, the aim of selection was altered to obtaining increased yield without loss of quality. The search for increased yield was amply rewarded by the strain D-31 which has in searching trials given increased yields of lint of 40% for 3 seasons in Zaria. As far as could be ascertained in the laboratory, the quality was not inferior and it was not until the lint had been spun into yarn and tested for strength that any inferiority was found. At

one time the introduction of a cotton that was in any way inferior in quality to that in general use would not have been considered. But having found a strain which gives such big increases of yield, it was felt that some moderate fall in quality, accompanied by a moderate fall in the price it would fetch, could be allowed. An attempt is being made therefore to ascertain the extent of the (inevitable?) reduction in the price this cotton will fetch. At the same time, because this strain is not by any means pure, there is the possibility that the quality may be improved without losing the yield. This is being followed up.

Besides the work on D-31, other strains, most of which are introductions from abroad, have been grown, some in observation plots and some in definite trials. Twenty out of the original 195 hybrid strains sent by Dr. Harland were given further trials on a small scale and SG.27, introduced from Uganda in 1931, was tested on a larger scale. Eight U.4 strains from South Africa were grown under observation. These would have been tested in trials before had not some of Dr. Harland's strains shown considerable promise. Unfortunately most of these which were promising in the field were found on examination at the Shirley Institute to be inferior in quality.

Work on cotton in the "Middle Belt" represented by Benue, Kabba, and Ilorin provinces has been held up owing to the difficulty of working with cotton in that area and to lack of staff.

PROGRESS REPORT ON COTTON SELECTION WORK IN THE SOUTHERN PROVINCES, SEASON 1935-1936.

BY

E. H. G. SMITH.

In contrast to the previous season, 1935/36 was very satisfactory and cotton strains under trial did well. Plants of improved Ishan strain A, grown for the annual re-selection, recovered from the low yield recorded for 1934/35, and a satisfactory supply of pure seed was obtained for multiplication.

Work proceeded with the Ishan A $\times$ Sea Island first and second backcrosses with Ishan A. (the Sea Island cotton was V.135). Twenty

selections of the first backcross of (Ishan A $\times$ Sea Island) $\times$ Ishan A (selfed twice) were received from St. Vincent and were grown. Unfortunately many strains raised in St. Vincent appear to be somewhat unsuited to Ibadan conditions on vegetative characters. These strains certainly seem to include valuable material for selection, but it appears that many years may elapse before satisfactory cottons for Ibadan conditions can be evolved from them. Mr. F. D. Golding, Senior Entomologist, reported as follows :—

“ I have made several examinations of the cotton in the selection plot with the object of studying insect incidence on the various strains. The outstanding feature of this examination was the comparatively large number of cotton Stainers (*Dysdercus* spp.) and jassids (*Empoasca fascialis*, Jac.) on certain of the plants raised in St. Vincent. These plants are characterised by their earliness of flowering and by the hairlessness of their leaves. In Southern Nigeria early-flowering cotton strains are liable to heavy Stainer attack, while those with hairless leaves often suffer severely from jassids. In one of the plots of Ishan A cotton this year there is an interesting example of the importance of hairiness as a protection against jassids. There is one hairless plant surrounded by plants with hairy leaves ; throughout the season there have been numerous jassids on the hairless plant while other plants have almost entirely escaped jassid attack. It appears that many of the plants grown from seed raised in St. Vincent are insufficiently late in their flowering and have not hairy enough leaves to avoid serious Stainer and jassid attack.”

The above observations by Mr. Golding illustrate what is meant when the importance of the valuable vegetative characters of improved Ishan strain A are stressed. Up to the present, several strains have been produced with better lint, but not one produced so far rivals Ishan A as regards yield, and disease and pest resistance. And the latter considerations are of paramount importance in Southern Nigeria.

As was feared in the previous year, none of the second backcrosses proved to have better lint than the Ishan parent. A number of first backcrosses, originally raised in St. Vincent or at Ibadan, were grown in progeny rows, and some selections were continued. Additional second backcrosses were also made for trial this coming season. It does not appear that there will be very much progress to report from Southern Nigeria for a number of seasons as the working through of the (Ishan A $\times$ Sea Island) $\times$ Ishan A backcrosses seems certain to be a slow and lengthy procedure.

The attempt to improve Ishan A lint by crossing with Sea Island, and then backcrossing with Ishan A has been made possible by the co-operation and assistance received from the Corporation's officers

in the West Indies. Now that all this work is transferred to Ibadan, I wish to acknowledge the invaluable help received. There have certainly been no spectacular results so far, but it is hoped that improvement as a result of this programme may be achieved in time. The absence of spectacular progress illustrates the difficulty of attempting to obtain improvement by raising new strains in one country for another. To sum up progress to date, it may be said that excellent linted strains produced in St. Vincent, and presumably satisfactory on vegetative characters there, have fallen down on these latter characters when transferred to Ibadan. However, as a result of this work we do possess possible material, and there are still some more recently produced St. Vincent strains that have yet to be tested here.

WEST INDIES.

COTTON EXPERIMENT STATION, ST. VINCENT, PROGRESS REPORT FOR THE SEASON 1935-36.

BY

S. H. EVELYN.

PLANT BREEDING EXPERIMENTS.

Sea Island Cotton.

Standard V.135.—As the staple length and quality of V.135 is now stabilised, an attempt is being made to increase yield by the selection of strains possessing high weight of lint per seed and high ginning percentage. Positive results were obtained this season and selection is being continued.

The multiplication of pure line V.135 seed at the Station and at Diamond Estate was continued. It will be remembered that plants with the highest number of bolls are selected for multiplication purposes each season at the Station. This season 15 selections were made, one of which had a total of 277 bolls—the highest number yet recorded at the Station for V.135. At Diamond Estate an area of 50 acres was planted with selfed V.135 seed from the Station from which 30,000 lbs. of seed was obtained for planting purposes.

Red Sea Island.—This season the 42 selections grown bred true for red plant body, weak corolla spot and superfine lint. They maintained their superiority to V.135 in weight of boll contents and ginning outturn, but were, with the exception of one strain, still inferior in mean number of bolls per tree and mean number of seeds per boll.

Lint measurements as high as 70 mm. were obtained which seem to indicate that these strains may now be as good as V.135.

The V.135 × Montserrat Sea Island hybrids.—The growth of these strains was, in general, not so good as in previous seasons and the unfavourable weather experienced from November onwards was responsible for much irregularity in the staple length of even single plants of strains which had bred true last season for superfine lint.

Variation in lint colour was observed, and where possible, selection for white lint has been practised. Fifty-seven strains were grown

of which thirty-three bred true to superfine length. Only nine of these, however, combined this character with a high weight of lint per seed. It is of interest to record that these selections, in comparison with the Red Sea Island strains, were in almost every case inferior in weight of boll contents.

Strains possessing superfine lint (57 mm. and over), intermediate length of staple (53–55 mm.), and short staple (50–52 mm.) have been selected for continuation. On account of the limited demand for cotton with the St. Vincent length of staple, the possibility is being investigated of developing in St. Vincent strains with heavier yield than V.135 and a length of staple approximately that of Montserrat cotton.

The Perennial Cottons.

Work on perennial cottons was abandoned at the end of this season as it was considered that the rainfall at the Station was too high to permit of useful results being obtained with cottons which were being selected for cultivation in regions of very low rainfall.

The material was accordingly transferred to the island of Carriacou, B.W.I., where only perennial cottons are cultivated.

The Ishan × Sea Island hybrids.

This season 63 selfed selections from a first backcross (Ishan × V.135) × Ishan, were grown and analysed. Many excellent strains were obtained which were superior to the Ishan control strain grown in St. Vincent. Most of the strains had lint indexes over 7.0 gms. in combination with a staple length of 40 millimetres and over, and ginning outturns ranging from 35% to 41.7%. The quality of the lint was, in almost every case, superior to Ishan.

As it was considered that this Station has gone as far as is possible with this work, all promising material was sent to Southern Nigeria and this experiment has now come to a close.

Selfed selections from a first backcross (Ishan × Red Sea Island) × Ishan were also sent at the end of the season to Southern Nigeria for trial as these showed much promise in St. Vincent.

The Asiatic × New World hybrids.

The Asiatic × U.4 hybrids.—Conditions did not seem to favour the growth of these hybrids this season. The strains remained in their seedling stage for an abnormal length of time and it is thought that the heavy rains experienced in the first two months of the season were responsible for this slow growth. For this reason maturation periods

were, in almost every case, later than they were last season. Nevertheless some very excellent strains were obtained which, under St. Vincent conditions, matured earlier than Standard U.4 and were superior in lint length and yield.

Some of the strains bred true for the Asiatic red gene, and the high resistance to Angular Leaf Spot disease was maintained.

It is considered that purification of these strains should be continued with the object of intercrossing them to combine in an even greater degree their early maturity, heavy yield and hairiness. At the end of the season selfed material was sent to Africa for trial.

A few of the outstanding characters of this season's selections are given with the object of demonstrating the progress that is being made. One selection completely matured its crop of 29 bolls in 119 days. Boll-splitting occurred in some cases 39 days from flower opening and eighty-nine days from the date of sowing. The highest lint index recorded was 9.5 gms. The highest mean lint length was 46.2 mm. and the highest ginning outturn was 44.2%.

The Asiatic × Upland hybrids.—Several selfed families from a fifth backcross (Asiatic × Triumph Upland) × Triumph Upland, were grown this season. Some of them matured relatively early and possessed the big boll character of the Upland parent.

One strain possessed a weight of seed cotton per boll of 6.39 gms. and its weight of lint per boll was 2.25 gms. Selfed material of these strains has been sent to South Africa for trial, meanwhile work has been suspended at the Station pending reports on the material sent.

Experiments with U.4.

U.4 strains from Rhodesia.—Several U.4 strains were received from Rhodesia via the Trinidad Research Station. None of them was as good as Standard U.4 and the material has been discarded.

The U.4 × Bourbon and Cambodia × Bourbon hybrids.—This season F₃ families from the crosses U.4 × Bourbon Intense Spot and Cambodia × Bourbon Intense Spot were grown. These families were discarded and the experiment closed, as the plants were almost glabrous, were perennial in habit and the weakness of the lint, its colour and weight per boll made them valueless for commercial cultivation.

It may be of interest to record that one family from the cross U.4 × Bourbon Intense Spot segregated for true chlorophyll deficiency in the ratio of 15 normals to 1 chlorophyll deficient.

GENETIC EXPERIMENTS.

Genetic investigations of the characters Corolla Colour, Corolla Spot and Leaf Callus Spot in the Sea Island strains AN, BD and SIW.

The corolla colour grades of the above strains are :—AN=9, BD=7, and SIW=3.

The data so far obtained indicate the following.—(a) A single factor pair operates for corolla colour in the above crosses, but the fact that grade 7 (BD) is dominant to grade 9 (AN) makes further observation necessary before a full explanation of the results can be given. In the F_1 , grade 3 (SIW) reduced grade 7 (BD) to grade 6.

(b) A strong positive correlation exists between corolla colour and corolla spot in these crosses, particularly in the crosses AN $\times$ SIW and BD $\times$ SIW.

(c) Corolla spot is simply inherited, but the results are masked by modifying factors. Repeated backcrossing tends to clarify the segregation between full and intermediate corolla spots.

(d) Leaf Callus Spot is simply inherited in these crosses. AN and BD both possess an intermediate leaf callus spot whereas in SIW the anthocyanin pigmentation at the leaf callus is almost absent.

(e) Leaf callus spot and boll loculus number are independent characters and bear no relation to corolla colour and corolla spot.

Investigations into the origin and genetic behaviour of a fuzzy seeded type of V.135.

In 1933 three completely fuzzed seeds were found in alleged pure line V.135 seed. When sown, these produced two clean-seeded plants and one completely fuzzy-seeded plant. Selfed progeny of one clean-seeded plant produced only clean seeds. Those of the other clean-seeded plant segregated in the ratio of 3 clean to 1 fuzzed and the progeny of the fuzzed plant bred true for fuzz.

Investigations are being continued, but it is suggested that fuzzy is a recessive mutation. Harland states that he once found a fuzzy recessive mutation in Montserrat Sea Island.

No segregation for other characters has so far been observed.

Investigations into the genetics of the characters—"Boll Loculus Number" and "Undeveloped Ovules" in Sea Island cotton.

These experiments are still in too early a stage to allow of conclusions being drawn.

Investigations into the genetics of a semi-sterile mutant of V.135.

This mutant was found by the writer in 1933 in a plot of pure line V.135. It is characterised by its habit of growth, semi-sterility of the pollen, reduced size of the flower, bolls, leaves and corolla spot,

and its possession of a high node number, a unique boll-shape and leaves which are tri-lobed.

Crossed with normal, the F_1 was intermediate for all major characters and quite fertile. F_2 families segregated in the ratio of 9 normals to 7 heterozygotes—only a single mutant appearing in a population of 131 plants. A first backcross to the mutant segregated in the ratio of 3 normals to 1 heterozygote. Two mutants appeared in the 24 plants of the 1st backcross.

Four selfed seeds of the mutant produced only normals. This suggested that chromosomal abnormality was occurring in the gametogenesis of the mutant. Dr. Skovsted, the cytologist at the Cotton Research Station, Trinidad, expressed the tentative opinion that the abnormal behaviour of the mutant might be caused by its possession of one or two extra chromosomes, as occurs in the spelt forms of wheat. Cytological examination is being pursued to determine this.

It was observed that the mutant and heterozygotes possessed fewer seeds per boll than the normals and a highly significant correlation, $r = -.73$, $T = 3.7$, was obtained between number of seeds per boll and node number.

Previous work of the writer's has shown that a significant negative correlation exists in V.135 between node number and number of bolls per tree. As yield is so dependent on these factors this work is being pursued with greater attention.

Investigations into the genetics of the character "Kidney" seeds.

F_2 families and first backcrosses of St. Vincent Kidney and Sea Island were observed this season. In the F_1 a small percentage of kidney seeds occurred. Although in the F_2 families and first backcross families the percentage of kidney seeds of the heterozygotes ranged from 1% to 99%, by classing them as heterozygotes the ratio for the F_2 families was 1 normal to 2 heterozygotes to 1 kidney, and that for the backcrosses 1 heterozygote to 1 kidney. In the backcross families a few plants were recorded as normals, but it is thought that the 100 seeds examined of each plant were insufficient to detect very small percentages of kidney seeds.

In conclusion, the results indicate that a single factor pair operates for the character "Kidney" in these crosses.

Hybridisation Work.

V.135 is being crossed and backcrossed with *G. armourianum*, *G. aridum* and Gambia to determine the commercial possibilities of such hybrids.

The Cotton Type Collection.

Almost two hundred cotton types were maintained this season in pure culture. New additions to this collection included Demak—an asiatic type from Java—a wild type from the Canary Islands and a representative collection of the cottons of British Honduras and the Virgin Islands.

A short note on the effect of environment on genetic characters.

In 1934 pure line V.135 seed was sent to the Canary Islands to determine what effect the different conditions would have on such a stable genetic character as lint length. Mr. T. H. J. Carroll who was at the time stationed at Teneriffe co-operated with the writer in this work and his co-operation is hereby gratefully acknowledged.

The plants were self-fertilized and the selfed material returned to this Station for analysis. In Teneriffe no phenotypic differences were observed but the plants were 5–6 weeks later in flowering and took about eight weeks longer to split their first bolls.

The lint on analysis was of a dirty white colour, wastey, very weak and very irregular in staple length. The lint length ranged from 45 mm. to 57 mm., whereas, grown in St. Vincent, the lint length range was 57 mm. to 63 mm. The seed weight remained about the same, but the lint index dropped from 4.4 gms. to 3.1 gms. and the ginning outturn from 25% to 20%.

The selfed seed obtained from Teneriffe was sown at the Station this season and produced only normal V.135 plants of normal length, lint index, and ginning outturn.

At Teneriffe the seed was sown on the 18th May, at an altitude of 650 feet. From May to October the temperature ranges from 74° to 76° F. and from November to April from about 60° to 68° F. In the summer the plants were irrigated, but rain sufficed during the winter. Growth was, in general, very irregular, even though the plants received dressings of sulphate of ammonia.

STAFF, BUILDINGS, VISITS.

Staff.—In April 1935, the Government provided this Station with a clerical assistant. Prior to the appointment, the laboratory assistant also performed the clerical work. The increase of work at the Station necessitated the use of the laboratory assistant for full time field and laboratory work.

This season's programme called for field work from both assistants during the observational and reaping periods and this opportunity is

taken of recording appreciation of the excellent work performed by these officers.

Buildings.—The Corporation authorised the erection of a greenhouse and a small potting shed and these were built during the season. These will be of invaluable help to the work of the Station, particularly as in St. Vincent a field close season is observed for three months of the year.

Visits.—The Station was visited during the season by the Controller—Sir Geoffrey Evans, Professor Cheesman, the Commissioner and Assistant Commissioner of Agriculture for the West Indies, Mr. Killby, Secretary of the Corporation, and Dr. Skovsted, Cytologist at the Cotton Research Station, Trinidad.

In January, the present Acting Curator of the Agricultural Department, Montserrat, spent three weeks in studying the methods of cotton selection practised at this Station. This is the second time an Agricultural Officer from Montserrat has made use of the Station for study purposes and it is considered that such visits should be encouraged. As a result of this visit the system of producing commercial pedigreed seed in Montserrat has been greatly improved.

At the request of the Commissioner of Agriculture for the West Indies the writer spent three weeks in Montserrat to report on the cotton selection work of that Island.

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